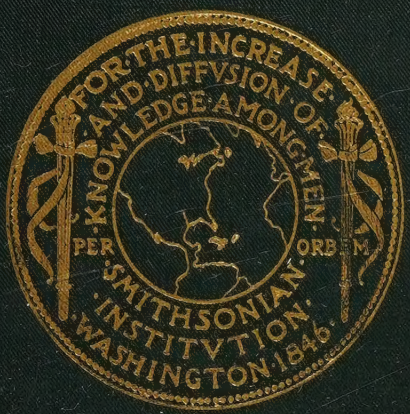
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The present volume is the fifty-sixth of this series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately, and, like the Proceedings, based chiefly on the collections of the National Museum.

A quarto form of the Bulletin, known as the "Special Bulletin," has been adopted in a few instances in which a larger page was deemed indispensable.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as Bulletins.

WILLIAM DEC. RAVENEL,
Administrative Assistant to the Secretary,
in charge of the United States National Museum.

MARCH 15, 1920.

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New names: *Bullaria quoyana*, *Turritellopsis (acicula variety) stimpsoni*, *Omphalius marianus*, *Margarites (Lirularia) inflatula*.

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———. Descriptions of new species of mollusks of the family Turritidae from the west coast of America and adjacent regions. No. 2288. August 8, 1919[1]..... 1–86

New species: *Turricula libya*, *T. (Knefastia) nigricans*, *T. (Surcula) laysanica*, *T. (S.) panthea*, *T. (S.) lavinia*, *Leucosyrinx galapagna*, *L. amycus*, *L. kincaidi*, *Cymatosyrinx hespera*, *C. elissa*, *C. lalage*,

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New varieties: *Leucosyrinx persimilis blanca, Antiplanes amphitrite beroe, Lora Tenuilirata cymata, Mangilia (Kurtziella) arteaga roperi.*

New names: *Lora lawrenciana, Philbertia trichodes.*

New section: *Carinodrillia.*

FOWLER, HENRY W. The fishes of the United States Eclipse Expedition to West Africa. No. 2294. August 8, 1919 [1] 195–292

New species: *Julis azorensis, Abudefduf ascensionis, Mormyrus goheeni, Labeo curriei, Tilapia savagei, Syngnathus peltegrini, Eutropius eclipsis, Caranx angolensis.*

GAHAN, A. B. Report on a small collection of Indian parasitic hymenoptera. No. 2299. October 20, 1919 [1] 513–524

New species: *Bruchophagus mellipes, Eurytoma parasae, E. denticoxa, E. dentipectus, E. setitibia, E. hindupurensis, Stomoceras ayyari, Neanastatus trochantericus, Aphycus fuscidorsum, Eupteromalus parnarae, Xestonotidea foersteri.*

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New species: *Gypona dictitoria, G. nixabunda, G. cacozela, G. occlusa, G. curiata, G. negotiosa, G. aquila, G. dracontea.*

GILMORE, CHARLES W. A mounted skeleton of Dimetrodon gigas in the United States National Museum, with notes on the skeletal anatomy. No. 2300. December 15, 1919[1] 525–539

———. New fossil turtles, with notes on two described species. No. 2292. July 30, 1919 [1] 113–132

New species: *Neurankylus wyomingensis, Boremys albertensis, Agomphus alabamensis, Aspideretes latus.*

HAY, OLIVER P. Descriptions of some mamalian and fish remains from Florida of probably Pleistocene age. No. 2291. July 31, 1919 [1] 103–112

New genus: *Thinobadistes.*

New species: *Thinobadistes segnis, Felis veronis, Atractosteus lapidosus.*

MCEWAN, EULA DAVIS. A study of the brachiopod genus Platystrophia. No. 2297. September 2, 1919 [1] 383–448

New species: *Platystrophia uniplicata, P. precedens, P. trentonensis, P. hermitagensis, P. extensa, P. elegantula, P. amoena, P. globosa, P. rhynchonelliformis, P. juvensis, P. strigosa, P. nitida, P. corryvillensis, P. sublaticosta, P. foerstei, P. attenuata, P. cumingsi, P. elkhornensis, P. preponderosa, P. fervalensis.*

New varieties: *Platystrophia daytonensis laurelensis, P. trentonensis champlainensis, P. t. perplana, P. elegantula triplicata, P. e. amplisulcata, P. amoena longicardinalis, P. precursor latiformis, P. p. angustata, P. foerstei ampla, P. ponderosa arnheimensis, P. unicostata crassiformis, P. cypha tumida, P. c. arcta, P. c. bellatula.*

MCGREGOR, E. A. The red spiders of America and a few European species likely to be introduced. No. 2303. January 8, 1920 [1] 641–679

New genera: *Anychus, Septanychus.*

New species: *Tetranychus pacificus.*

TIMBERLAKE, P. H. Revision of the parasitic Chalcidoid flies of the genera Homalotylus Mayr and Isodromus Howard, with descriptions of two closely related genera. No. 2293. August 29, 1919 [1] 133–194

New genera: *Anisotylus, Brethesia.*

New species: *Homalotylus mexicanus, H. quaylei, H. africanus, H. cockerelli, H. affinis, H. brevicauda, H. hyperaspidis, H. punctifrons, Anisotylus pallentipes, Isodromus axillaris, Brethesia latifrons.*

New subspecies: *Anisotylus similis texanus, A. s. utahensis.*

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TOWNSEND, CHARLES H. T. New genera and species of Muscoid flies. No. 2301. December 15, 1919 [1] 541–592

New genera: *Neomuscina, Euphormia, Chlorosarcophaga, Bufolucilia, Petrosarcophaga, Tephromyopsis, Opsidiopsis, Hypenomyia, Megaeuloewia, Steveniopsis, Opelousia, Phasiophyto, Punamyocera, Sturmiodexia, Leptodexia, Hesperodinera, Schistostephana, Opsotheresia, Pterinopterna, Eutorocca, Micromintho, Metallicomintho, Parazelia, Minthozelia, Opsozelia, Parathelaira, Lydellothelaira, Thelairochaetona, Anaporia, Microaporia, Trochiloglossa, Beskioleskia, Urochaetona, Pseudochaetona, Minthomyia, Telothyriosoma, Microchaetona, Opsoleskia, Oestroplagia, Vibrissovoria, Matucania, Leptomacquartia, Aubaeanetia, Stomatolydella, Anametopochaeta, Urodexodes, Phrynolydella, Austrolydella, Meigenielloides, Proroglutea, Myothyriopsis, Topomeigenia, Parameigenia, Ollachea, Opsomeigenia, Machairomasicera, Ochromeigenia, Zosteromeigenia, Neoscotia, Phrynofrontina, Eutritochaeta, Minthohoughia, Casahuiria, Gymnocarcelia, Eocarcelia, Neowinthemia, Xeoprosopa, Pachynocera, Xanthoactia, Aphantorhapha, Trichotopteryx, Incamyiopsis, Metatachina, Aravaipa, Charapemyia, Neoerigone, Bezzimyia, Atrypoderma.*

New species: *Neomuscina cavicola, Chlorosarcophaga cochliomyia, Petrosarcophaga arizonica, Opsidiopsis oblata, Hypenomyia petiolata, Megaeuloewia morinioides, Steveniopsis sinuata, Opelousia obscura, Phasiophyto fumifera, Ormia brevicornis, O. dominicana, Punamyocera oroyensis, Sturmiodexia rubescens, Leptodexia gracilis, Hesperodinera cinerea, Schistostephana aurifrons, Opsotheresia obesa, Pterinopterna ciliata, Trichoduropsis guianensis, Eutorocca fasciata, Micromintho melania, Metallicomintho abdominalis, Parazelia pulchra, Minthozelia montana, Opsozelia discalis, Parathelaira panamensis, Lydellothelaira collaris, Thelairochaetoma thrix, Pseudeuantha octomaculata, Microaporia elegans, Trochiloglossa tropica, Beskioleskia busckii, Urochaetona longipes, Urodexia siamensis, Pseudochaetona polita, Minthomyia abdominalis, Telothyriosoma tersa, Microchaetona gracilis, Opsoleskia flava, Oestroplagia petiolata, Vibrissovoria petiolata, Matucania mellisquama, Leptomacquartia planifrons, Xanthocera atra, Aubaeanetia assimilis, Stomatolydella infernalis, Anametopochaeta olindoides, Urodexodes charapensis, Phrynolydella polita, Austrolydella assimilis, Meigenielloides cinerea, Proroglutea piligera, Myothyriopsis bivittata, Topomeigenia matutina, Ollachea elongata, Machairomasicera carinata, Ochromeigenia ormioides, Zosteromeigenia mima, Phrynofrontina convexa, Eutritochaeta carpocapsae, Minthohoughia cylindrica, Casahuiria cornuta, Gymnocarcelia ricinorum, Eocarcelia ceylanica, Neowinthemia abdominalis, Xeoprosopa uruhuasi, Crocuta lutea, Pachynocera petiolata, Aphantorhapha arizonica, Trichotopteryx tropica, Incamyiopsis imitatrix, Metatachina mellifrons, Aravaipa atrophopoda, Charapemyia calida, Chrysotachina peruviana, Neoerigone cinerea, Copecrypta andina, Bezzimyia busckii.*

New names: *Neoscotia, Schaumia desvoidyi.*

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DESCRIPTIONS OF NEW SPECIES OF MOLLUSKS OF THE FAMILY TURRITIDAE FROM THE WEST COAST OF AMERICA AND ADJACENT REGIONS.

By William Healey Dall,

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INTRODUCTION.

In the course of my revision of the marine mollusk-fauna of Western America it became necessary to take up the present family, which was in a regretable state of confusion. This involved a review of the generic nomenclature as well, since it was well known that many invalid names were currently used, following the early work of Doctor Carpenter and others.

Circumstances connected with the war made a general revision of the nomenclature of the family impracticable. A revision of the genera chiefly concerned with the West American species and a bibliography of names which had been used for groups connected with the family was, however, possible and has already been issued.[1]

The present paper is to be construed in the light of the data presented in the above-mentioned publication. In reviewing the fauna from San Diego northward it became necessary to include to a great extent that of the regions south of the United States boundary, since experience had shown, in connection with a study of the bivalves, that a certain proportion of the species extended their range not only into the Panamic fauna but even as far south as Peru.

In going over the material in the collection of the United States National Museum a large number of new forms were discovered, and their description forms the subject of this paper. A few of the species of Doctor Carpenter are now figured for the first time from his types. In all somewhat over 200 species are considered, of which 181 are new. Of these 93 belong to the fauna of the western coast of the United States from the Arctic Ocean to San Diego, California, including one species from our Hawaiian territory. Eleven species belong to the west coast of South America and its faunal connection, the Galapagos Islands; 89 belong to the Panamic fauna and its northern extension into the Gulf of California and the shores of the Californian peninsula.

[1] Proc. U. S. Nat. Mus., vol. 54, No. 2238, pp. 313–333, Apr. 5, 1918.

Quite a number of the species are from considerable depths, obtained during the explorations made by the United States Bureau of Fisheries steamer *Albatross;* and another large contingent is due to my own dredgings on the coast of Alaska and in Bering Sea during 1871 to 1880.

I am also under great obligations to a host of collectors in our Pacific States, who have with the greatest liberality intrusted me with material for study which has added much to our knowledge of the fauna and incidentally to the national collection.

To Mrs. E. M. Decker much credit is due for the careful retouching of the microphotographs of the new species from a study of the typical specimens under the compound microscope. And to Dr. Paul Bartsch, curator of invertebrates, United States National Museum, I am under many obligations for assistance in various ways during the preparation of the figures.

Some question having been raised as to the spelling of the family name which I have retained as first proposed by Henry and Arthur Adams in 1853, I submitted the question of "Turridæ *versus* Turritidæ" to two expert Latinists, who, after due consideration of all the data, concluded that, while either was correct, the latter term under the circumstances was to be preferred.

DESCRIPTIONS OF THE SPECIES.

Family TURRITIDAE.

Subfamily TURRITINAE.

TURRICULA LIBYA, new species.

Plate 2, fig. 5.

Shell solid, fusiform, the apex eroded, the surface white, covered with a blackish olive periostracum and having about seven (decollate) whorls; suture strongly appressed, obscure; anal fasciole wide, smooth, concave, the sulcus wide and shallow, close to the suture; spiral sculpture of a few feeble threads on the earlier whorls; axial sculpture of (on the penultimate whorl nine or ten, on the last whorl only three or four) short prominent riblets extending from the fasciole protractively forward to the succeeding suture on the spire; on the last whorl there is on the later part only an angle at the anterior edge of the fasciole; base moderately convex, aperture narrow, with a deep anal sulcus and a prominently arcuate, thin, sharp-edged outer lip; inner lip with a thin layer of white callus; pillar thick and solid, attenuated in front; axis not pervious, canal short, wide, not recurved. Height of (slightly decollate) shell, 40; of last whorl, 24; diameter, 13 mm. Cat. No. 96576, U.S.N.M.

Range.—Station 2830, off Cape San Lucas, in 66 fathoms, sand; U. S. Bureau of Fisheries.

The absence of the operculum makes the generic position somewhat doubtful.

Subgenus KNEFASTIA Dall.

Type.—Pleurotoma olivacea Sowerby, 1833, not of Reeve, 1843, +*funiculata* Valenciennes, 1839.

This includes such species as *P. duplicata* Sowerby and *olivacea* Tryon, of the Panamic fauna.

TURRICULA (KNEFASTIA) NIGRICANS, new species.

Plate 2, fig. 6.

Shell slender, acute, blackish brown with the anterior part of the last whorl pale reddish brown, a conspicuous periostracum, a closely appressed suture separated by a single cord from the constricted anal fasciole; whorls nine, without the (lost) nucleus; axial sculpture of (on the last whorl eight) prominent angular ribs with wider interspaces, beginning abruptly at the shoulder rapidly dwindling anteriorly and obsolete on the base; these ribs are crossed by (on the last whorl about 14) widely spaced slender cords, slightly nodulous at the intersections; aperture narrow, anal sulcus shallow, outer lip sharp, simple, a slight subsutural callus, the inner lip erased, the pillar straight, the canal wide and very slightly recurved. Height of shell, 38; of last whorl, 22; diameter, 11 mm. Cat. No. 96664, U.S.N.M.

Range.—Off Lower California in 21 fathoms sand. U. S. Bureau of Fisheries steamer *Albatross.*

This species belongs to the group of *T. olivacea* and *duplicata* Sowerby, though much more slender and differently sculptured.

TURRICULA (SURCULA) LAYSANICA, new species.

Plate 1, fig. 4.

Shell slender, fusiform, yellow brown with a broad white peripheral band, and a less well-defined one in front of the suture and the base, with eight well-rounded whorls exclusive of the (lost) nucleus; the suture appressed, the fasciole in front of it constricted, with only incremental lines; axial sculpture of about 15 slender rounded somewhat sigmoid ribs; these are crossed by (on the penultimate whorl seven or eight, on the last whorl more than 15) flattened cords with narrower almost channeled interspaces, toward the canal with intercalary threads, on the canal four or five with much wider interspaces; aperture ovate, outer lip thin, anal sulcus wide, not deep, with no subsutural callus, canal straight. Height of shell, 52; of last whorl and canal, 33; diameter, 15 mm. Cat. No. 274121, U.S.N.M.

Range.—Laysan Island, North Pacific Ocean; W. H. Golisch.

TURRICULA (SURCULA) PANTHEA, new species.

Plate 1, fig. 5.

Shell solid, acute, fusiform, white, with pale brown blotches between the ribs (the nucleus lost), with about 14 whorls; suture closely appressed, obscure with a rounded thread in front of it; anal fasciole close to the suture slightly depressed, spirally threaded, arcuately striated; spiral sculpture on the early whorls consisting of a peripheral keel with one strong thread behind it, the rest of the surface finely closely spirally threaded; the last three or four whorls peripherally waved with narrower interspaces over which the keel and thread are a little swollen, the fine threading continuing; the space in front of the keel on the last whorl with about 25 strong cords with wider interspaces; aperture narrow, anal sulcus distinct, without a subsutural callus; outer lip produced, thin, smooth inside, inner lip with a thin wash of enamel, the pillar straight, the canal long, narrow, with no siphonal fasciole or recurvation. Height of shell without the nucleus, 47; of last whorl, 28; diameter, 13.5 mm. Cat. No. 212348, U.S.N.M.

Range.—Station 2795, in Panama Bay, in 33 fathoms, bottom temperature 64.1° F., U. S. Bureau of Fisheries.

TURRICULA (SURCULA) LAVINIA, new species.

Plate 1, fig. 6.

Shell rather coarse with about a dozen whorls, the color yellowish or light brown, the nucleus smooth, slightly bulbous; suture strongly appressed with a spiral cord in front of it, the whorls moderately shouldered; the anal fasciole somewhat concave, spirally striate; axial sculpture of (on the last whorl about 12) protractively oblique rounded ribs with subequal interspaces, prominent on the periphery, attenuated on the base and not reaching the canal; incremental lines sharp, sometimes almost threadlike; spiral sculpture of (from three to five on the spire, about 10 on the last whorl) strong, rounded cords overriding the ribs and not swollen at the intersections, the interspaces subequal and sometimes with an intercalated smaller thread; lastly the surface is finely minutely spirally striate in the intervals between the larger threads and cords; aperture narrow, anal sulcus close to the suture, short and rounded, with a subsutural callus; outer lip produced, thin edged, more or less crenulate from the spiral sculpture, smooth within; inner lip and pillar with a rather thick layer of callus with slightly raised outer edge; pillar straight; siphonal fasciole feeble; canal short, wide, recurved. Height of shell, 49; of last whorl, 26.5; diameter, 16 mm. Cat. No. 56085, U.S.N.M.

Range.—West coast of Mexico.

LEUCOSYRINX PERSIMILIS BLANCA, new variety.

Shell differing from the original *persimilis* by the well-marked spiral sculpture being continuous over the whole surface and by the pronounced depressed spiral area on each side of the convex anal fasciole, which with the ridge at the shoulder gives the effect of two parallel ridges behind the periphery. Height of shell, 60; of last whorl, 44; diameter, 22 mm. Cat No. 214337, U.S.N.M.

Range.—Off Cape Blanco, Oregon, in 1,064 fathoms, mud, bottom temperature 35.9° F. U. S. Bureau of Fisheries steamer *Albatross.*

? LEUCOSYRINX GALAPAGANA, new species.

Plate 3, fig. 2.

Shell small for the genus, white under a straw-colored periostracum, thin, with about seven whorls exclusive of the (lost) nucleus; suture appressed, the edge slightly swollen, the fasciole in front of it slightly constricted; axial sculpture of about a dozen narrow rounded ribs with wider interspaces, beginning at the fasciole and obsolete on the base; also fine incremental lines rising to minute wrinkles near the suture; spiral sculpture on the penultimate whorl of about nine flattish threads with narrower interspaces, on the last whorl beyond these threads the interspaces become channeled grooves and the places of the threads wider flat areas, while on the canal these are replaced by more rounded closer threads; aperture narrow, the anal sulcus very shallow, outer lip thin, sharp, arcuate, simple; pillar and body erased, smooth, the pillar attenuate in front; canal narrow, straight. Height of shell, 20; of last whorl, 14; diameter, 7 mm. Cat. No. 96494, U.S.N.M.

Range.—Off the Galapagos Islands in 634 fathoms, coral sand, bottom temperature 40° F. U. S. Bureau of Fisheries steamer *Albatross.*

I felt some uncertainty as to whether this deep-sea species should be referred to *Surcula* or *Leucosyrinx*, as the shell characters partake of the characteristics of both to some extent.

LEUCOSYRINX AMYCUS, new species.

Plate 3, fig. 7.

Shell white with an ashy brown periostracum and six or more whorls, the apex eroded; suture slightly appressed, especially on the spire; anal fasciole wide and deep, somewhat in front of the suture and extending to a moderate peripheral carina; behind the carina the shell is feebly, and in front of it strongly spirally grooved with wider flat interspaces; aperture simple, outer lip thin, produced, inner lip erased, white, pillar gyrate but not pervious, canal distinct and slightly recurved. Height of shell, 52; of last whorl, 40; diameter, 20 mm. Cat. No. 204049, U.S.N.M.

Range.—Off Monterey Bay, California; in 871 fathoms, sand, bottom temperature about 38° F. U. S. Bureau of Fisheries steamer *Albatross.*

LEUCOSYRINX KINCAIDI, new species.

Plate 3, fig. 8.

Shell of moderate size, fusiform, with an acute spire and elongated canal, waxen white, nucleus of two smooth bulbous whorls with five subsequent whorls; axial sculpture only of faint incremental lines; spiral sculpture including a very prominent thin sharp peripheral keel and fine spiral striae with wider interspaces, over most of the surface; the interspaces become more rounded and coarser on the base; the entire space between the keel and the preceding suture may be said to form the anal fasciole, the wide arcuate sulcus being situated a little way in front of the suture; the base is neatly rounded and contracted at the beginning of the canal; outer lip thin, sharp, much produced in front, inner lip slightly erased; pillar obliquely attenuated in front, gyrate, and with a minutely pervious axis; canal narrow, slender; operculum yellowish, ovate, with an apical nucleus. Height of shell, 29; of last whorl, 21.5; diameter, 13 mm. Cat. No. 151581, U.S.N.M.

Range.—Shelikoff Strait, north of Kodiak Island, Alaska; Prof. Trevor Kincaid.

This very distinct species is extremely thin and fragile, indicating a deep water habit.

CYMATOSYRINX HESPERA, new species.

Plate 20, fig. 2.

Shell small, white, polished, acute, with a small, smooth, glassy, inflated nucleus of one and a half whorls, with seven and a half subsequent whorls; suture appressed, obscure; anal fasciole immediately in front of it, constricted; spiral sculpture none; axial sculpture of (on the penultimate whorl 11) more or less sigmoid strong rounded ribs crossing the whole whorl, feebler on the base and fasciole, nearly continuous up the spire and with subequal interspaces; incremental lines rather regularly spaced and evident; aperture narrow with a varicosity behind the thin produced outer lip, anal sulcus conspicuous, rounded, with a marked subsutural callus; inner lip and pillar with a thin callus with a raised edge; canal distinct, constricted, deep, short, recurved, forming a keeled siphonal fasciole. Height of shell, 9; of last whorl, 4.5; diameter, 3.5 mm. Cat. No. 122799 U.S.N.M.

Range.—Station 2805, in Panama Bay, in 51 fathoms muddy bottom; U. S. Bureau of Fisheries.

CYMATOSYRINX ELISSA, new species?.

Plate 20, fig. 1.

A possible variety of the above, smaller, with a larger pinkish nucleus, eight or nine straighter ribs, not continuous up the spire, and

some very faint indications of spiral striae near the canal. There are in all seven whorls less inflated and with a less constricted fasciole. Height of shell, 7; of last whorl, 4; diameter, 2.5 mm. In other respects similar to the preceding. Cat. No. 122799*a*, U.S.N.M.

Range.—Same as the preceding.

? CYMATOSYRINX LALAGE, new species.

Plate 20, fig. 3.

Shell small, pinkish white, polished, acute, with a smooth nucleus of about two whorls and five subsequent hardly rounded whorls; spiral sculpture of a few obscure threads on the canal; suture obscure, strongly appressed; anal fasciole slightly constricted; axial sculpture of (on the penultimate whorl nine) strong rounded ribs most prominent at the periphery, extending from suture to suture, with subequal interspaces, obsolete on the last half of the last whorl and on the base; incremental lines irregular, obscure; there is a hump-like varix some distance behind the outer lip; aperture narrow, anal sulcus conspicuous, rounded, with a heavy subsutural callus; outer lip thin with no internal lirae, moderately produced; inner lip callous, pillar short, thick, canal wide, very short, hardly differentiated from the aperture. Height of shell, 8; of last whorl, 5; diameter, 3 mm. Cat. No. 55491, U.S.N.M.

Range.—Gulf of California, Stearns collection.

This form is somewhat intermediate between *Kylix* and *Cymatosyrinx*.

CYMATOSYRINX PLICATELLA Dall.

Plate 20, fig. 4.

Clathurella plicatella DALL, Bull. Mus. Comp. Zoöl., vol. 43, No. 6, p. 289, Oct. 1908.

Range.—Station 2799, in Panama Bay, in 29½ fathoms muddy bottom; U. S. Bureau of Fisheries steamer *Albatross*.

Type-specimen.—Cat. No. 110604, U.S.N.M. This shell is smaller than most of the forms referred to this group, but appears to have all the proper characters, though in miniature.

? CYMATOSYRINX FERMINIANA, new species.

Plate 8, fig. 4.

Shell white, with a yellowish base, slender, acute, with a swollen smooth white nucleus of about two whorls and six subsequent whorls; suture appressed, on the earlier whorls the posterior edge is prominent; whorls moderately rounded; spiral sculpture absent from the spire, on the last whorl hardly visible except on the extreme anterior base and siphonal fasciole where there are a few impressed lines; axial sculpture of (on the last whorl 12) somewhat sigmoid ribs, feebly arcuate on the anal fasciole, strongest in front of it, rather

sharp-edged, extending mostly over the base, and with somewhat wider interspaces; they are not continuous up the spire; aperture rather narrow, the anal sulcus conspicuous, with a subsutural callus; outer lip thin, sharp, with a ribless space and a small varix behind it, smooth internally; inner lip and pillar callous, smooth; canal distinct, small, narrow, short, somewhat recurved, with an evident siphonal fasciole. Height of shell, 14.2; of last whorl, 7.5; diameter, 5 mm. Cat. No. 214267, U.S.N.M.

Range.—Station 3034, off Point San Fermin, Lower California, in 24 fathoms, gray mud; U. S. Bureau of Fisheries.

This shell is slightly decorticated and may have been polished when fresh. It is somewhat intermediate in character between *Elaeocyma* and *Cymatosyrinx*.

? CYMATOSYRINX PALMERI, new species.

Plate 19, fig. 7.

Shell small, brilliantly polished, light brown, with six whorls exclusive of the (lost) nucleus; suture distinct, closely appressed, undulated by the axial sculpture; anal fasciole constricted; spiral sculpture none; axial sculpture of (on the last whorl 10) rounded sigmoid ribs, feebler where they cross the fasciole, fading out on the base, and most prominent at the periphery, with subequal interspaces; aperture moderately wide, anal sulcus large, close to the suture, with a thick subsutural callus; outer lip thickened with no internal lirae, a knob-like varix a little way behind it; body and pillar callous, siphonal sulcus deep, canal wide, short, slightly recurved. Height of (decollate) shell, 9.5; of last whorl, 7; diameter, 4 mm. Cat. No. 56036, U.S.N.M.

Range.—Beach at the head of the Gulf of California, collected by Dr. E. Palmer.

In another lot of specimens bleached white (No. 56040) one or two have a few more ribs and a few faint spiral lines on the base, but they appear to be only mutations of the same species, and are from the same locality. This is another of those species which seem intermediate between *Elaeocyma* and *Cymatosyrinx*.

CYMATOSYRINX IDOTHEA, new species.

Plate 21, fig. 11.

Shell small, thin, acute, rose pink, not polished, with a blunt nucleus of one and a half smooth inflated whorls, and five well rounded subsequent whorls; suture distinct, appressed, the adjacent fasciole constricted; spiral sculpture none; axial sculpture of (on the last whorl about a dozen) protractively oblique sigmoid riblets, faint on the base and practically absent from the fasciole, with subequal interspaces; aperture moderately wide; anal sulcus wide and deep, adjacent to the suture and with no subsutural callus; outer

lip thin, sharp, prominently produced; inner lip erased, pillar stout, short, white, obliquely attenuated in front; canal wide, short, hardly differentiated from the aperture. Height of shell, 9; of last whorl, 5; diameter, 4 mm. Cat. No. 96194, U.S.N.M.

Range.—Station 2777, in the Straits of Magellan, in 20 fathoms, gravel; U. S. Bureau of Fisheries.

The aperture of the specimen figured is defective.

CYMATOSYRINX HECUBA, new species.

Plate 20, fig. 9.

Shell small, acute, rosaceous, solid, with six whorls, excluding the (damaged) nucleus, differing from the preceding species by its more slender shell, wider fasciole, over which the ends of the ribs reach the preceding suture, forming a more pronounced shoulder at the periphery, and having the whole shell spirally sculptured by small equal threads with subequal interspaces. The pillar is longer and the canal distinct, longer, and somewhat constricted. Otherwise the shells are very similar and the nucleus, though damaged, appears to have been of the same character. Height of shell, 11; of last whorl, 6.5; diameter, 4.5 mm. Cat. 73995, U.S.N.M.

Range.—Gulf of California; Stearns collection.

This was named *rosacea* by Carpenter in manuscript, but is not the *rosacea* of Mighels, in 1845. The surface is polished, but that may be due to wear, as it is evidently a beach specimen. The aperture is incomplete in the specimen.

ELAEOCYMA IANTHE, new species.

Plate 4, fig. 6.

Shell acute, polished, white with touches of brown on the anal fasciole and on the last whorl behind the varix; nucleus blunt, the first whorl smooth, the second peripherally carinate; subsequent whorls eight, moderately rounded; suture distinct, appressed, somewhat undulate, the anal fasciole narrow, slightly constricted; spiral sculpture of (on the penultimate whorl 3 or 4) incised lines in front of the periphery, the wider interspaces raised and more or less rounded, on the last whorl there are 16 or more, extending to the canal; the incised lines have a more opaque appearance contrasting with the translucent white of the whorls; there is no fine spiral striation; axial sculpture of (on the penultimate whorl about a dozen) strong, wide ribs less prominent on the fasciole and fading out on the base and the last half of the last whorl; the interspaces equal or sometimes wider; the ribs are cut by the incised lines but are not nodulose; they are most prominent on the anterior half of the whorls of the spire and on the periphery of the last whorl; aperture narrow, anal sulcus deep and rounded, with a prominent subsutural

callus; outer lip sharp-edged, with a moderate varix behind it, arcuately produced; inner lip with a rather thick layer of enamel; canal distinct, rather wide, somewhat recurved. Height of shell, 17; of last whorl, 8.7; diameter, 6.5 mm. Cat. No. 212367, U.S.N.M.

Range.—Station 3020, off Cape Tepoca, Gulf of California, in 7 fathoms, sand and shelly bottom, United States Bureau of Fisheries.

This is one of the most elegant of the smaller species of the group.

ELAEOCYMA ATTALIA, new species.

Plate 18, fig. 7.

Shell small, slender, acute, white, polished, with eight flattish whorls exclusive of the (lost) nucleus; suture obscure, appressed, fasciole immediately adjacent, rather wide, and constricted; spiral sculpture of a few incised lines on the base and threads on the canal; axial sculpture of (on the penultimate whorl about fourteen) low feeble ribs, almost knoblike, stronger on the earlier whorls, but which do not reach the base or cross the anal fasciole and which disappear on the last half of the last whorl where there is a moundlike varix and traces of a yellowish spot; aperture small, anal sulcus deep, with a subsutural callus; outer lip thin, sharp, arcuately produced; inner lip and pillar with a thin layer of enamel; pillar short, canal very short and hardly differentiated from the aperture. Height of shell, 8.5; of last whorl, 4; diameter, 3 mm. Cat. No. 168677, U.S.N.M.

Range.—West coast of Mexico, probably near Mazatlan.

The specimen is translucent white, but is not improbably more or less bleached.

ELAEOCYMA ARBELA, new species.

Plate 4, fig. 3.

Shell small, glistening, acute, brownish, with the projecting sculpture paler; nucleus dark brown, glassy, rather irregularly coiled, of one smooth whorl followed by a peripherally keeled turn and about eight subsequent whorls; suture distinct, appressed, with a nodulose band in front of it where the ends of the ribs are cut off by a very narrow fasciolar constriction; spiral sculpture of a few incised lines cutting only the interspaces between the ribs, on the spire; on the last whorl there are six or seven of these lines, with much wider interspaces, followed by three strong cords close-set on the canal; axial sculpture of (on the last whorl about 13) protractively oblique whitish narrow ribs extending from the fasciole to the cords of the canal, with subequal interspaces and not continuous up the spire; incrementatl lines evident, silky; aperture narrow, anal sulcus deep and rounded, with a strong subsutural callus; outer lip sharp-edged, with a feeble varix and a brown spot behind it; inner lip and pillar with a thick coat of white enamel, the throat not lirate; canal

constricted, very short, deep, and slightly recurved. Height of shell, 13.7; of last whorl, 6.5; diameter, 5 mm. Cat. No. 106495, U.S.N.M.

Range.—Scammon Lagoon, Lower California, collected by Henry Hemphill.

ELAEOCYMA HALOCYDNE, new species.

Plate 4, fig. 4.

Shell slender, acute, rather flat-sided, purplish brown usually more or less obscured by a yellowish white glaze; nucleus with the first turn smooth, inflated, the second has a peripheral keel and is followed by about eight and a half subsequent whorls; suture strongly appressed with a smooth narrow band in front of it and behind the somewhat constricted fasciole; other spiral sculpture of sharply incised lines, four or five on the spire between the sutures, equal and with wider equal rounded interspaces, and about 24 on the last whorl, the interspaces becoming more cord-like near the canal and sometimes feebly nodulous where the lines cut the ribs; axial sculpture of (on the penultimate whorl about 18) feeble narrow ribs, stronger near the apex, obsolete on the last whorl, with wider interspaces, beginning in front of the fasciole, hardly reaching the base, and protractively oblique; there are also fine sharp incremental lines, chiefly evident in the depressions, but here and there finely reticulating the interspaces; aperture rather wide, anal sulcus conspicuous, rounded; outer lip thin, prominently arcuate, smooth within; inner lip with a thin layer of brownish enamel, the edge raised anteriorly; canal distinct, slightly constricted, with a small concentrically striated siphonal fasciole. Height of shell, 18; of last whorl, 10; diameter, 6 mm. Cat. No. 216748, U.S.N.M.

Range.—Station 203, off San Pedro; University of Southern California.

ELAEOCYMA AEOLIA, new species.

Plate 3, fig. 1.

Shell small, brilliantly polished, pinkish brown, with a minute smooth-pointed nucleus of three whorls and seven subsequent whorls; suture distinct, appressed, constricted, and slightly undulated by the sculpture; spiral sculpture of (on the spire two) incised lines in front of the shoulder with much wider interspaces, on the last whorl there are about 10, extending to the canal; axial sculpture of (on the last whorl 11) rounded protractively oblique ribs, somewhat lighter colored than the body of the shell, extending from the shoulder to the base and not crossed by the incised lines, the interspaces subequal, the ribs not continuous up the spire; aperture rather wide, and sulcus well marked, short and close to the suture; outer lip thickened, the edge sharp; inner lip erased, pillar short, canal wide, short, slightly recurved. Height of shell, 7; of last whorl, 3.5; diameter, 2.5 mm. Cat. No. 208592, U.S.N.M.

Range.—Station 3020, off Cape Tepoca, Gulf of California, in 7 fathoms, sand, and shell; U. S. Bureau of Fisheries.

ELAEOCYMA EMPYROSIA Dall.

Plate 4, fig. 1.

Drillia empyrosia DALL, Nautilus, vol. 12, No. 11, p. 127, March, 1899; Proc. U. S. Nat. Mus., vol. 24, No. 1264, p. 516, pl. 39, fig. 5, March, 1902.

Elaeocyma empyrosia DALL, Proc. U. S. Nat. Mus., vol. 54, No. 2238, p. 317, April 5, 1918.

Range.—Off San Pedro, Cal., in moderate depths of water.

This is the typical species of *Elaeocyma.*

ELAEOCYMA ABDERA, new species.

Plate 4, fig. 5.

Shell small, acute, thin, of a dull waxen color with a darker blotch behind the aperture and a dark brown nucleus of a whorl and a half, smooth and polished, and nine subsequent whorls; spiral sculpture of obscure fine threads, on the last whorl in addition there is a more prominent duplex thread in front of the suture; on the base are four other widely separated threads only prominent as nodules at their intersection with the line of the ribs; there are six or more finer threads on the canal; axial sculpture of (on the last whorl 7 or 8) ribs which appear at the periphery as conspicuous nodules and become obsolete on the base except at the intersections above mentioned; there are also fine, sharp, close, arcuate incremental lines on the anal fasciole; the peripheral nodules are more riblike and numerous on the earlier part of the spire; aperture short, rather wide, the anal sulcus deep, oval, almost tubular; outer lip moderately thickened, sharp-edged, smooth inside, with a prominent knob behind it; inner lip smooth with a rather thick layer of enamel continued down the pillar with a raised edge and a chink behind it; canal short and wide, hardly differentiated, with an inconspicuous siphonal fasciole. Height of shell, 15; of last whorl, 8; diameter, 6 mm. Cat. No. 212373, U.S.N.M.

Range.—Panama Bay at station 2798, in 18 fathoms, sandy bottom. U. S. Bureau of Fisheries.

This specimen is not as brilliantly polished as most of the species of the group which, however, may be due to wear.

ELAEOCYMA AEGINA, new species.

Plate 4, fig. 2.

Shell brownish, pale on the early whorls, with a whitish glaze, polished, acute, except for the nuclear apex, which is flattened; nucleus smooth, polished, of two whorls, the second sharply keeled and passing gradually into the sculpture of the subsequent eight and a half whorls; suture strongly appressed behind the concave arcuately

striated anal fasciole; axial sculpture of (on the last whorl 10) prominent protractive ribs extending from the fasciole to the succeeding suture on the spire and somewhat over the periphery on the last whorl; these ribs are knob-like and prominent on the periphery and rapidly diminish forward; incremental sculpture faint; spiral sculpture begins on the early whorls with about four faint striæ which grow sharper on the later whorls which carry four or five grooves with wider flattish interspaces between the periphery and the succeeding suture, with on the later whorls sometimes one or two on the anal fasciole, on the last whorl there are 16 or more in all; the last rib on the last whorl is more swollen than the others and usually darker in color; aperture narrow, outer lip thin, sharp, produced, smooth internally with a deep rounded anal sulcus close to the suture with a heavy lump of callus on the side of the body; inner lip with a rather thick callus with a raised edge extending to the end of the pillar; canal short, wide, deeply cut, with a small keel bordering the posterior edge of the siphonal fasciole. Operculum dark brown. Height of shell, 13; of last whorl, 6.5; diameter, 4.8 mm. Cat. No. 266371, U.S.N.M.

Range.—Agua Verde Bay, Gulf of California, Dr. Paul Bartsch.

? ELAEOCYMA AEROPE, new species.

Plate 1, fig. 3.

Shell small, acute, whitish, with a polished, smooth, trochiform nucleus of about two and a half whorls and eight or more subsequent whorls; suture distinct, slightly appressed, anal fasciole slightly constricted; spiral sculpture of sharp narrow grooves, with much wider flat smooth interspaces; there are about eleven of the grooves on the last whorl between the shoulder and the spirally threaded siphonal fasciole; the anal fasciole is not spirally striate; axial sculpture of (on the last whorl about 10) sharp-edged ribs, with wider interspaces, compressed and arcuate on the anal fasciole, nearly vertical elsewhere and extending over the whole whorl, but not continuous over the spire; incremental lines inconspicuous; aperture rather wide and short with a deep rounded anal sulcus and prominent subsutural callosity; outer lip subvaricose, sharp-edged, smooth within; inner lip with a thick layer of enamel; its outer edge raised with a slight chink between it and the siphonal fasciole; pillar short, straight; canal deep, short, wide, and slightly recurved. Height of shell, 16; of last whorl, 8; diameter, 6 mm. Cat. Nos. 266398, U.S.N.M. (showing nucleus) and 266311, U.S.N.M. (adult shell).

Range.—Agua Verde Bay, Lower California, Dr. Paul Bartsch.

The specimen has a dull surface, which is probably due to wear.

CLATHRODRILLIA PAZIANA, new species.

Plate 5, fig. 1.

Shell small, acute, pale olivaceous, with 10 whorls, of which the first nuclear is smooth, the second obscurely peripherally keeled, the subsequent whorls normally sculptured; suture distinct, the periphery of the upper whorls nearer the succeeding than the preceding suture; anal fasciole constricted but crossed by the ribs; spiral sculpture of (on the upper whorls 4 or 5, on the last whorl about 14) strong cords with narrower groove-like interspaces, extending from the fasciole to the canal; the cords not swollen where they cross the ribs; axial sculpture of (on the penultimate whorl 13, on the last whorl 10) rounded ribs with subequal interspaces, strongest at the shoulder, extending from suture to base, the incremental lines rather strong on the fasciole; anal sulcus deep and rounded with callous margin, the outer lip arcuate, thin; the inner lip simple, canal slightly recurved. Height of shell, 13; of last whorl, 7; diameter, 5 mm. Cat. No. 311372, U.S.N.M.

Range.—La Paz, Lower California.

Though small, this is a typical *Clathrodrillia.*

CLATHRODRILLIA LIMANS, new species.

Plate 13, fig. 3.

Shell small, of a warm yellow brown, with a blunt short smooth nucleus of a whorl and a half and five or more subsequent moderately rounded whorls; suture distinct, appressed, moderately constricted with three or four fine spiral striae on the fasciole; spiral sculpture of (on the penultimate whorl between the fasciole and the succeeding suture about six) fine equal, equally spaced threads, with narrower deep interspaces, forming minute nodules where they cross the ribs, on the last whorl the threading continues hardly altered, to the end of the canal; axial sculpture (on the penultimate whorl about 35) narrow ribs with subequal interspaces, extended from the fasciole to the canal, forming a very uniform reticulation over the whole surface; aperture (the outer lip defective) rather wide, the inner lip erased, the pillar short, stout, whitish; the canal very short and wide, hardly differentiated from the aperture. Height of shell, 7; of last whorl, 4; diameter, 3.5 mm. Cat. No. 56218, U.S.N.M.

Range.—Gulf of California; Stearns collection.

This shell was sent to Dr. Philip Carpenter by Stearns and returned to him with the above manuscript name, but never published. The aperture when complete is probably of the usual *Clathrodrillia* type.

CLATHRODRILLIA CASTIANIRA, new species.

Plate 2, fig. 1.

Shell small, white, apex eroded, having five or more whorls exclusive of the (lost) nucleus; whorls well rounded, anal fasciole excavated, close to the appressed suture; spiral sculpture of (on the upper whorls in front of the fasciole, three, on the last whorl about a dozen between the fasciole and the end of the canal) strong, equal, equally spaced, rounded threads with wider smooth interspaces; axial sculpture of (on the penultimate whorl 14) low riblets barely reaching the base and starting from the shoulder, with subequal interspaces, and becoming obsolete near the aperture; they are subnodulous at the intersections with the spirals; aperture rather wide, anal sulcus deep, close to the suture with a subsutural callus; inner lip erased; outer lip thin, hardly varicose; canal distinct, short, recurved. Height of shell, 10; of last whorl, 6; diameter, 4.5 mm. Cat. No. 214246, U.S.N.M.

Range.—Station 3189, off Cape San Martin, California, in 218 fathoms, mud, bottom temperature 43.2° F. U. S. Bureau of Fisheries.

CLATHRODRILLIA AENONE, new species.

Shell yellowish brown, of about seven whorls exclusive of the (lost) nucleus, spire acute, the whorls markedly shouldered, the suture strongly appressed with a strong cord in front of it; anal fasciole excavated, arcuately striated, with a few obscure fine spiral threads running in it; axial sculpture of (on the last whorl fifteen) short prominent nearly vertical subrectangular ribs rounded above and confined to the peripheral region in front of which on the base of the last whorl are about twice as many thread-like ridges mostly continuous over the base to the beginning of the canal; incremental lines rather marked; spiral sculpture of three or four threads with wider interspaces overrunning and sometimes slightly nodulating the peripheral ribs; in front of these on the base are about eight spiral threads conspicuously nodulous at the intersections with the minor ridges. and with much wider interspaces; on the younger shells these threads are more close set, fewer and less nodulous, the minor ridges inconspicuous; finally between these in the adult are more or less distinct finer spiral striae; the canal is also spirally threaded with a conspicuous siphonal fasciole; aperture rather narrow with a well-marked anal sulcus close to the suture, and on the body a prominent subsutural callus; outer lip produced, sharp-edged, smooth within; inner lip callous, the outer edge of the enamel slightly raised, and on the canal prominent with a chink between it and the siphonal fasciole; canal short, recurved; height (without the nuclear whorls),

35; height of last whorl, 18; diameter, 12 mm. Cat. No. 266370, U.S.N.M.

Range.—Agua Verde Bay, Lower California; Dr. Paul Bartsch. The outer lip is more or less crenulated at the edge by the spiral sculpture.

? CLATHRODRILLIA RESINA Dall.

Plate 2, fig. 4.

Turris (*Surcula*) *resina* DALL, Bull. Mus. Comp. Zoöl., vol. 43, No. 6, p. 264, 1908.

Range.—Station 3354, Gulf of Panama, in 322 fathoms, mud, bottom temperature 46° F. U. S. Bureau of Fisheries steamer *Albatross*. Cat. No. 123103, U.S.N.M.

This species is intermediate between *Clathrodrillia* and some of the species of *Surcula*, but on the whole is nearer the former by its sculpture and the latter in its straight canal.

CLATHRODRILLIA CALLIANIRA, new species.

Plate 5, fig. 2.

Shell slender, acute, pale brownish, with a smooth regularly increasing nucleus of two and a half whorls and eight and a half subsequent whorls; suture closely appressed with a cord-like edge behind the strongly constricted, arcuately striated anal fasciole: spiral sculpture of (on the penultimate whorl about seven) flattish, close-set cords; in some specimens these alternate in size, in others they are nearly equal; on the last whorl there are about 25, some irregularly larger than the others, and a few smaller threads on the canal; axial sculpture of (on the last whorl 10 to 14) rounded ribs with subequal interspaces, more conspicuous and less numerous as we ascend the spire, over which the spiral sculpture passes without nodulation; aperture short, subovate, anal sulcus short rounded, with a subsutural callus; outer lip arcuate, thin, smooth inside, without any marked varix behind it; inner lip and pillar with a smooth callus; canal short, slightly recurved. Height of shell, 16; of last whorl, 8.5; diameter, 5.5 mm. Cat. No. 96722, U.S.N.M.

Range.—Station 2823, off Lower California in 27 fathoms, sand, U. S. Bureau of Fisheries.

CLATHRODRILLIA ANDROMEDA, new species.

Plate 2, fig. 2.

Shell acute, fusiform, whitish with a brown periostracum; nucleus small, the apex minutely globular and, with the succeeding inflated whorl, smooth; subsequent whorls eight, regularly increasing in diameter; suture closely appressed, obscure, bordered in front by two undulated cords, the anterior cord larger; axial sculpture of (on the last whorl 18) equal narrow nodulous ribs with subequal interspaces,

the ribs extending well over the base from the anterior margin of the anal fasciole, where they form a marked shoulder; the incremental lines are hardly noticeable except on the fasciole; spiral sculpture of (on the spire three) strong cords, the posterior slightly larger, which become swollen and nodulous where they intersect the summit of the ribs; on the last whorl there are 7 of these cords and 10 minor threads in front of the base and on the canal; in the interspaces between the major cords there are from one to three fine threads which do not become nodulous; anal fasciole narrow, concave, somewhat removed from the suture, the sulcus shallow; in the type-specimen the outer lip is thin and sharp, the inner lip erased, but if the specimen is immature the outer lip would probably be thickened with a subsutural callus in the adult; pillar straight, attenuated in front, white; canal distinct, not recurved. Height of shell, 16.5; diameter, 8.5 mm. Cat. No. 211516, U.S.N.M.

Range.—Station 2828, in 10 fathoms, off La Paz, Lower California. U. S. Bureau of Fisheries.

CARINODRILLIA, new section.

For the species in which the spiral sculpture predominates and in which there is a tendency for the peripheral cord to form a carina, the name *Carinodrillia* is proposed with *Clathrodrillia halis* Dall, as the type. This forms a very natural group containing a large number of species mostly unicolor, whitish or brownish.

CLATHRODRILLIA (CARINODRILLIA) HALIS, new species.

Plate 5, fig. 4.

Shell yellowish white, elongated, acute, with two polished, more brownish nuclear whorls and nine subsequent whorls; suture appressed with an angular thread in front of it, separated by an excavated wide fasciole, microscopically spirally striated, from an acute shoulder surmounted by a single cord; other spiral sculpture of (on the last whorl nine) widely separated subequal cords on the posterior one of which the suture is laid; these have the interspaces minutely striated and are not swollen when they pass over the ribs; axial sculpture of (on the last whorl six) short, very prominent ribs with narrower interspaces, not continuous up the spire and horizontally angulated by the cord which forms the periphery; they undulate the succeeding suture but are obsolete on the base and anal fasciole; on the early part of the spire the peripheral cord is duplex, but the posterior thread gradually fades out; aperture narrow, anal sulcus deep, rounded, outer lip thin, sharp, arcuately produced; inner lip erased, pillar short, canal very short but distinct. Height of shell, 20; of last whorl, 10; diameter, 7 mm. Cat. No. 211649, U.S.N.M.

Range.—Station 2822, off La Paz, Lower California, in 21 fathoms, sand, U. S. Bureau of Fisheries.

If the specimen is not quite mature the aperture may prove to be more elaborate in the adult. The shell is intermediate in type between *Suavodrillia* and *Clathrodrillia*. The soft parts being absent the presence of an operculum is tentatively assumed.

CLATHRODRILLIA (CARINODRILLIA) ALCESTIS, new species.

Plate 5, fig. 6.

Shell slender, acute, pale yellowish brown (the nucleus lost), with about ten whorls; suture strongly appressed with a prominent cord (afterwards broadening into a band) in front of it; siphonal fasciole constricted; with only arcuate striation; sculpture on the early whorls of two or three strong cords, swollen where they override the ribs, these are prominent on the periphery; on the later whorls the peripheral cord becomes an undulated keel and the interspaces are closely spirally striate; on the last whorl in front of the keel are about a dozen major threads with wide spirally striate interspaces; axial sculpture of (on the last whorl seven) peripheral waves, rather than ribs, overridden by the spirals, the incremental lines inconspicuous; aperture narrow, anal sulcus slightly removed from the suture, distinct, with a small subsutural callus; outer lip moderately produced, sharp edged, slightly crenulate by the spiral sculpture, smooth within; inner lip with a moderate layer of callus, with slightly raised outer edge which is continued over the pillar and on the canal is separated from the feeble siphonal fasciole by a narrow chink; canal short, wide, slightly recurved. Height of shell (without the nucleus), 30; of last whorl, 16.5; diameter, 8 mm. Cat. No. 212354, U.S.N.M.

Range.—Station 3037, off Guaymas in the Gulf of California in 20 fathoms green mud. U. S. Bureau of Fisheries.

CLATHRODRILLIA (CARINODRILLIA) THESTIA, new species.

Plate 5, fig. 3.

Shell slender, acute, strongly sculptured, with pale brownish clouding on a yellowish white ground; nucleus smooth, inflated, of a whorl and a half, followed by about eight sculptured whorls; suture distinct, undulated, strongly appressed, thick-edged, with a strong cord immediately behind the strongly constricted smooth anal fasciole; other spiral sculpture of (on the spire one or two) strong peripheral cords, swollen and almost angulated where they override the ribs; on the last whorl there are six or seven cords with much wider interspaces and as many more smaller close-set threads on the canal; axial sculpture of seven or eight very prominent short ribs on the penultimate whorl; fading out on the last whorl, and rather prominent widely spaced incremental lines most conspicuous on the last whorl; aperture subovate, anal sulcus conspicuous, rounded, with a marked

subsutural callus; outer lip thin, moderately arcuate, not varicose, inner lip with a coat of enamel with the anterior edge raised; pillar short, straight, the canal hardly differentiated from the aperture. Height of shell, 14; of last whorl, 7; diameter, 5 mm. Cat. No. 56038, U.S.N.M.

Range.—On the beach at the head of the Gulf of California, collected by Dr. E. Palmer.

CLATHRODRILLIA (CARINODRILLIA) HALIPLEXA, new species.

Plate 5, fig. 5.

Shell with 12 whorls, excluding the (defective) nucleus, pale brown, acute, with inconspicuous suture, with eight or nine prominent axial ribs with equal or wider interspaces and faint incremental lines; anal fasciole wide, constricted, a single strong cord and fine spiral threads between it and the suture; in front of the fasciole are about six strong cords slightly swollen as they override the ribs, with much wider interspaces occupied by fine spiral threads, the cord at the periphery stronger than the rest; the base with threads of intermediate size, close-set; outer lip sharp, arcuate, undulate by the ends of the spiral cords; anal sulcus short, pear shaped with no subsutural callus; body throat and pillar white, smooth, canal short, recurved. Height of shell, 27; of last whorl, 13; diameter, 8 mm. Cat. No. 212355, U.S.N.M.

Range.—Station 2824, near La Paz, Lower California, in 8 fathoms; U. S. Bureau of Fisheries steamer *Albatross.*

? CLATHRODRILLIA (LAEVITECTUM) EBURNEA Carpenter.

Plate 13, fig. 5.

Drillia eburnea Carpenter, Proc. Zool. Soc. London, 1865, p. 280; not *Pleurotoma eburnea* Bonelli, 1842.

This differs from all the other species of the group in having all the sculpture obsolete, so that the shell except on very close scrutiny appears perfectly smooth except near the apex. The color is a pinkish white, with a brownish decollate apex. I have been puzzled where to put it, as it combines characters of several groups but feebly expressed.

Range.—Gulf of California, Rowell. Type, Cat. No. 22817, U.S.N.M.

? CLATHRODILLIA (KYLIX) ALCMEŃE, new species.

Shell small, pinkish white, polished, acute, with a flat-topped nucleus of two polished, prominently peripherally keeled whorls and about eight subsequent whorls; suture appressed, with a retractively nodulous, thickened band in front of it, forming the posterior margin of the anal fasciole; sculpture of (on the last whorl 22) somewhat sigmoid rounded ribs with subequal interspaces, reaching from

the suture over the whorl to the canal, constricted over the narrow anal fasciole and feebler on the anterior part of the last whorl; these ribs are cut into subnodulous segments by deep narrow sharp spiral grooves, with much wider interspaces, two or three on the spire, nine or ten between the fasciole and the canal on the last whorl; on the canal are five or six coarse close-set threads: aperture (probably not quite mature) rather narrow, anal sulcus narrow, not deep; outer lip thin, sharp, prominently arcuate; inner lip erased; pillar short, twisted, canal short, hardly differentiated. Height of shell, 13.5; of last whorl, 6.5; diameter, 5 mm. Cat. No. 268911, U.S.N.M.

Range.—Dredged at Agua Verde Bay, Gulf of California, by Dr. Paul Bartsch.

In the adult the aperture would doubtless be more elaborated.

? CLATHRODRILLA (KYLIX) ALCYONE, new species.

Plate 2, fig. 3.

Shell small, slender, acute, white, polished, with about nine whorls (the nucleus decorticated); suture distinct, not appressed, the anal fasciole adjacent to it with no thickened cord between: whorls well rounded but the fasciole flattish; spiral sculpture of (on the early whorls two, on the last whorl about 15) sharply incised lines in front of the shoulder cutting the ribs into squarish segments which are hardly nodulous; on the canal there are a few finer closet-set threads; axial sculpture of (on the penultimate whorl about 21) rounded somewhat sigmoid ribs, extending from the suture to the base, feeble on the fasciole and base and obsolete on the last half of the last whorl; anal fasciole wide and showing the arcuate posterior ends of the ribs which do not undulate the suture; aperture narrow, anal sulcus wide and rounded with slightly flaring edge; outer lip thin, sharp, prominently arcuately produced; inner lip erased, pillar strong, attenuated in front, canal distinct, narrow, somewhat recurved. Height of shell, 15; of last whorl, 8; diameter, 4.5 mm. Cat. No. 223150, U.S.N.M.

Range.—Station 3016, on the west coast of Mexico off Cape Lobos, in 76 fathoms, mud, bottom temperature 59° F. U. S. Bureau of Fisheries.

This species resembles *C. alcmene*, but is more slender, less nodulous, and without the prominent band in front of the suture. It has every appearance of being adult, though it has not the characteristic *Clathrodrillia* aperture and color and should it prove that this is the normal condition these two species might form a distinct section characterized by the incised sculpture, simple aperture and more delicate shell, which might take the sectional name of *Kylix*. It is not certain that either species is operculate like the true *Clathrodrillia*. The present species might be regarded as the type. The name will date from 1918.

PSEUDOMELATOMA PENICILLATA Carpenter.

Plate 22, fig. 3.

Drillia penicillata CARPENTER, Journ. de Conchyl., ser. 3, vol. 12, p. 146, April, 1865.

The poor condition of Carpenter's unfigured type specimen led to the belief that it was best to figure a perfect if somewhat immature example. The name has been variously applied, especially to forms of *Moniliopsis*, in ignorance of the true character of the species.

Range.—Cerros Island to Gulf of California.

CRASSISPIRA ERIGONE, new species.

Plate 7, fig. 8.

Shell solid, biconic, acute, olive brown with a purplish aperture; nucleus with two whorls, the first minute, smooth, rounded, the second with a peripheral keel, followed by eight sculptured whorls; suture appressed, obscure, behind a strongly constricted anal fasciole sculptured with almost microscopic spiral striae; other spiral sculpture of small obsolete threads covering the whole surface in front of the fasciole and three or four cords on the base of the last whorl widely separated and conspicuously nodulous where they cross the ribs; there are also 10 or more closer cords on the canal; axial sculpture of (on the spire about a dozen) short narrow ribs, very prominent and almost angular in front of the fasciole and on the last whorl extending nearly to the canal, with wider interspaces and not nodulous behind the base; the incremental lines are very fine and minutely crenulate the fine spiral sculpture in places; aperture narrow, anal sulcus short, rounded, with a strong subsutural callus; outer lip thin, smooth inside, moderately arcuate, with a hump-like varix behind it; inner lip and straight pillar with a thin layer of enamel, raised anteriorly at the edge; canal short, not deep, hardly differentiated from the aperture. Height of shell, 20; of last whorl, 12.5; diameter, 9 mm. Cat. No. 212368 U.S.N.M.

Range.—Station 2798, in Panama Bay, in 18 fathoms; U. S. Bureau of Fisheries.

CRASSISPIRA EURYNOME, new species.

Plate 7, fig. 5.

Shell small, slender, acute, dark brown with a whitish peripheral and a less obvious basal band; nucleus blunt, polished, reddish brown, of two whorls; subsequent whorls six, the anal fasciole on the spire depressed, very minutely spirally striated with a single fine thread near the posterior edge which is appressed at the suture; other spiral sculpture of fine striae and three stronger threads with

wider interspaces on the base; the canal has about half a dozen smaller closer threads; axial sculpture of nine oval prominent nodules on the periphery, which may in some specimens be bisected by an incised spiral line; the incremental lines are not prominent; aperture rather wide and short; anal sulcus large, deep, with a small subsutural callus; outer lip sharp edged, with a small varix, internally not lirate; canal short, wide, deep, with a perceptible siphonal fasciole and slightly recurved. Height of shell, 10; of last whorl, 5.5; diameter, 3 mm. Cat. No. 59345, U.S.N.M.

Range.—Beach at Acapulco, Mexico; W. H. Dall.

The specimen is slightly beach worn and the sculpture is probably sharper when fresh.

CRASSISPIRA CANDACE, new species.

Plate 6, fig. 6.

Shell small, pale purple with touches of brown, the nucleus lost, with about seven subsequent short whorls; suture appressed, obscure, behind a moderately impressed anal fasciole with a fine thread between them; other spiral sculpture of (on the spire) two peripheral close-set threads overriding the ribs; in front of these on the last whorl are two or three obscure broad flattish ridges with rather wide interspaces overridden by the axial sculpture, and on the canal a few rather sharp threads more closely set; axial sculpture of 10 or more short ribs on the penultimate whorl with narrower interspaces; on the last whorl there are about 13 smaller ribs extending nearly to the canal and reticulating the spiral sculpture; the incremental lines are rather marked; aperture wide and short, anal sulcus large, rounded, with a subsutural callus; outer lip thin-edged, prominent, with a large rounded varix behind it, within dark brown, smooth; inner lip simple, pillar very short, not callous, canal very short but distinct. Height of shell, 7; of last whorl, 3.5; diameter, 2 mm. Cat. No. 73929, U.S.N.M.

Range.—Gulf of California, Stearns collection.

This shell is so small and its sculpture so intricate that its description is not easy.

CRASSISPIRA APPRESSA Carpenter.

Plate 7, fig. 2.

Drillia appressa CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 14, p. 45, July, 1864.

Range.—Cape San Lucas, J. Xantus. Cat. No. 4087, U.S.N.M.

CRASSISPIRA DIRCE, new species.

Plate 6, fig. 3.

Shell acute, dark brown (the nucleus lost) with about a dozen whorls, the spire acute, rather flat sided; axial sculpture only of faint

incremental lines, spiral sculpture of two prominent cords, the space between them wider than the space between either and the nearer suture; there is a third cord over which the suture is laid and appressed, sometimes left uncovered; the posterior cord is simple or only slightly undulated, the anterior is at first undulate and later develops spirally elongate keeled nodulations about ten to a whorl, on the last whorl there are three undulated and five simple cords, the nodules being usually lighter colored than the rest of the shell; the surface also has fine regular, close-set uniform spiral striation; aperture short, ovate, with smooth lips; outer lip somewhat varicose with a short, rounded anal sulcus and prominent parietal callus; canal hardly differentiated. Height of shell, 23.5; of last whorl, 12.5; diameter, 8.5 mm. Cat. No. 55461, U.S.N.M.

Range.—Panama, Stearns collection.

The reticulated marking on the figure is due to Polyzoa which have been removed.

CRASSISPIRA NEPHELE, new species.

Plate 7, fig. 1.

Shell small, biconic, acute, solid, black with the projecting sculpture yellow, with a rounded nucleus of one and a half smooth whorls and eight subsequent whorls; suture closely appressed, obscure, behind a series of very fine close threads (about four on the last whorl) followed by a very strong yellow cord which on most of the spire forms the periphery, in front of this cord is the moderately constricted anal fasciole similarly threaded; in front of this is (on the spire one, on the last whorl two) a series of yellow nodules (about a dozen on the last whorl) rather distant from one another and connected by a small yellow cord, like beads on a string; the two series on the last whorl are close together, only separated by a much smaller thread, giving a dumb-bell shape to the nodules; in front of this pair on the last whorl are four distant yellow threads with single nodules placed in harmony with the larger ones above mentioned and half a dozen finer threads on the canal; the interspaces between the threads are finely threaded like the fasciole, and are often minutely decussated by the incremental lines which form the only axial sculpture; aperture narrow, anal sulcus shallow, rounded, with a subtural callus; inner lip smooth, erased, pillar callous, smooth, canal short, wide, hardly differentiated from the aperture. Height of shell, 13; of last whorl, 7.5; diameter, 5 mm. Cat. No. 55472, U.S.N.M

Range.—Panama, Stearns collection.

This species seems by coloration and sculpture different from the numerous other forms of this group which swarm at Panama, but

the range of variation requires thorough investigation before one can be certain of the specific status of any of them.

CRASSISPIRA EPICASTA, new species.

Plate 7, fig. 4.

Shell small, slender, acute, black, or very dark reddish brown, with two smooth nuclear whorls, the second with a peripheral keel, and seven subsequent whorls; suture obscure, appressed, with a marked thread at its edge; spiral sculpture of fine spiral striae over the entire shell, and (on the spire two or three, on the last whorl eight) stronger cords undulated but not nodulated where they pass over the axial sculpture, and separated by wider interspaces; the anal fasciole hardly constricted; axial sculpture of fine sharp incremental lines cutting the minor spirals and, on the last whorl about 13 low rounded ribs extending from the fasciole nearly to the canal but not conspicuous anywhere, with equal or narrower interspaces; aperture small, dark brown, the anal sulcus shallow and the thin outer lip only moderately arcuate; inner lip and pillar simple, canal short, hardly differentiated from the aperture. Height of shell, 9; of last whorl, 4.5; diameter, 3.5 mm. Cat. No. 204102, U.S.N.M.

Range.—Beach of Taboguilla Island, Panama Bay; U. S. Bureau of Fisheries.

CRASSISPIRA BRIDGESI, new species.

Plate 7, fig. 7.

Shell small, solid, grayish, with six whorls exclusive of the (lost) nucleus; suture strongly appressed, obscure with a thread-like edge in front of which is a narrow spirally striated space bordered in front by a larger cord forming the posterior margin of the anal fasciole: the fasciole is strongly constricted, undulated by the ribs and spirally striated; other spiral sculpture of (on the upper whorls one, on the later two) peripheral cords which are swollen where they pass over the ribs and on the anterior of which the suture is laid; on the last whorl there are six such cords with much wider spirally striated interspaces, and about five closer threads on the canal; axial sculpture of (on the last whorl six) strong rounded ribs almost continuous up the spire, most prominent at the periphery and feeble on the base; aperture narrow, with a varicose rib behind it; anal sulcus short, with a strong subsutural callus, inner lip erased, pillar with a thin layer of callus, smooth, short, with a very short deep canal forming an evident siphonal fasciole. Height of shell, 11; of last whorl, 5.5; diameter, 5 mm. Cat. No. 55254, U.S.N.M.

Range.—Panama, in the Stearns collection, collected by Thomas Bridges.

This shell, being somewhat bleached, is probably of a darker color when fresh.

CRASSISPIRA BACCHIA, new species.

Plate 6, fig. 1.

Shell solid, biconic, acute, slate gray with whitish projections; nucleus (eroded) of two brownish whorls, apparently smooth, and nine subsequent whorls; suture distinct, appressed, bordered by a small thread behind and a strong white cord in front between it and the fasciole which is constricted narrow and minutely spirally striated; other spiral sculpture of (on the spire two) peripheral whitish cords, the anterior stronger and swollen where it passes over the ribs; on the last whorl in front of the periphery are seven similar but smaller cords with wider, minutely striated interspaces sometimes carrying an intercalary thread; on the canal are about half a dozen close-set threads; axial sculpture of (on the last whorl 10) short rounded ribs prominent only on the periphery and extending from the fasciole to the canal, with subequal interspaces; there is also a prominent rounded varix behind the outer lip; outer lip sharpedged, smooth internally; anal sulcus conspicuous, rounded, short, with a strong subsutural callus; inner lip erased, dark purple as well as the throat; pillar straight, short, canal hardly differentiated from the aperture. Height of shell, 14.5; of last whorl, 7.5; diameter, 5.5 mm. Cat. No. 212372, U.S.N.M.

Range.—Station 2824, off La Paz, Lower California, in 8 fathoms, sandy bottom. U. S. Bureau of Fisheries.

It is quite likely that the color of this species varies and may be darker or lighter.

CRASSISPIRA TEPOCANA, new species.

Plate 6, fig. 5.

Shell solid, livid purple under a very dark olive periostracum, of about six whorls exclusive of the (lost) nucleus; suture strongly appressed behind a constricted anal fasciole; spiral sculpture of (on the penultimate whorl about nine) strong flattish threads, equal all over the surface and without intercalary striae; having narrower interspaces on the spire and equal or wider ones on the last whorl; axial sculpture of (on the last whorl about 10) sharp edged narrow nearly straight ribs reaching nearly to the canal from the fasciole, with much wider interspaces; aperture narrow, dark purple; anal sulcus rounded, short, with a strong subsutural callus; outer lip thin, slightly arcuate, smooth within, having a feeble varix behind it; inner lip with a thick layer of enamel, having a raised edge anteriorly; canal short hardly differentiated from the aperture; siphonal sulcus deep, forming an evident fasciole. Height of shell, 19; of last whorl, 12; diameter, 8 mm. Cat. No. 224415, U.S.N.M.

Range.—Station 3018, off Cape Tepoca, Lower California, in 36 fathoms, sand, bottom temperature 63.3° F.; U. S. Bureau of Fisheries.

CRASSISPIRA ARSINOË, new species.

Plate 6, fig. 4.

Shell biconic, acute, dark brown with paler projections and a reddish brown nucleus of two smooth whorls followed by nine subsequent whorls; suture closely appressed, obscure, somewhat undulated with two fine threads and a garland of elongated paler nodules between it and the constricted spirally grooved anal fasciole; other spiral sculpture of on the last whorl sharp narrow channeled grooves with wider flattish interspaces, which cut the axial sculpture into nodules, there are half a dozen closer threads on the canal; there is apart from the fasciole no finer spiral striation such as is found in most of the species of the group; axial sculpture of (on the last whorl about 14) feeble ribs beginning at the fasciole, obsolete on the base and only prominent as single, double, or triple nodules at the shoulder, there are four or five rather distant spiral rows of nodules between the shoulder and the canal; the incremental lines are very fine and sharp; aperture narrow, anal sulcus wide and shallow with a marked subsutural callus; outer lip thin sharp, smooth inside, with no very evident varix behind it; throat brownish, inner lip and pillar with a smooth layer of enamel, the anterior edge raised on the canal; the latter short wide, hardly differentiated from the aperture. Height of shell, 17; of last whorl, 9.5; diameter, 7.5 mm. Cat. No. 56135, U.S.N.M.

Range.—Bartolomé Bay, Lower California, H. Hemphill.

? CRASSISPIRA RUGITECTA Dall.

Plate 7, fig. 6.

Turris (*Crassispira*) *rugitecta* DALL, Proc. U. S. Nat. Mus., vol. 54, No. 2134, p. 226, April 5, 1918.

Shell solid, acute, dark reddish brown, with a pale peripheral band and eleven rapidly enlarging whorls exclusive of the (lost) nucleus; suture closely appressed, obscure, with four or five strong spiral cords between it and the anterior edge of the anal fasciole which is moderately constricted; between this and the succeeding suture are five or six rather close-set flattish cords, obsolete on the summits of the ribs, the whole surface polished; on the last whorl there are about 14 of these cords extending to the canal near which there are a few intercalary smaller cords but no fine spiral striation; axial sculpture of (on the last whorl 16) nearly vertical ribs with narrow interspaces, beginning abruptly in front of the fasciole and becoming obsolete on the base; incremental lines rather strong; anal sulcus wide, rounded, not deep, separated from the suture by a strong

cord; aperture reflecting the colors of the exterior; outer lip short, sharp, arcuate; pillar and body smooth, canal very short, a little recurved. Height of shell, 30.5; of last whorl, 16; diameter, 10. mm. Cat. No. 266911, U.S.N.M.

Range.—San Bartolomé Bay, Lower California, Dr. Paul Bartsch.

This elegant species appears to be a *Crassispira*, but lacks the fine spiral striation and black color characteristic of the latter group.

? CRASSISPIRA AMATHEA, new species.

Plate 6, fig. 2.

Shell solid, marbled with brown and white, the brown chiefly as a broad dark peripheral band with a narrower band just behind the canal; nucleus blunt, brown, of two smooth whorls, followed by about six subsequent whorls, suture obscure, appressed, with a strong whitish ridge in front of it behind a rather wide constricted fasciole; spiral sculpture of fine striae covering the whole surface; axial sculpture of (on the last whorl about a dozen) short ribs extending from the fasciole to the canal and most prominent at the shoulder, with three nodules on the basal part of each rib; on the spire they are more like nodules than ribs; aperture wide, outer lip thickish, with a feeble varix behind it; anal sulcus distinct, shallow, with a large subsutural callus; inner lip with a moderate layer of enamel the anterior edge of which near the canal is raised, with a chink between it and the siphonal fasciole; canal wide, deep, very short, constricted, with a well marked siphonal fasciole. Height of shell, 22; of last whorl, 12; diameter, 8 mm. Cat. No. 56099, U.S.N.M.

Range.—Purchased from a native at Acapulco, Mexico, by W. H. Dall.

The shell is polished, but this may be due to the manner in which it has been cleaned by the seller.

? CRASSISPIRA MARTINENSIS, new species.

Plate 13, fig. 4.

Shell brownish, with two smooth nuclear and seven subsequent whorls; suture distinct, with a strongly nodulous ridge between it and the anal fasciole which is retractively arcuately wrinkled; the body is strongly sculptured with about a dozen rounded cords with narrower interspaces, not swollen where they pass over (on the penultimate whorl 14) close rounded ribs which extend to the periphery and are obsolete beyond it; aperture defective. Height, 18; of last whorl, 12; diameter, 8 mm. Cat. No. 162669, U.S.N.M.

Range.—Gulf of California at Cape San Martin.

MONILIOPSIS GRIPPI, new species.

Plate 8, fig. 2.

Shell slender with about eight (slightly decollate) whorls, livid olivaceous with a pale peripheral band, lighter near the aperture;

suture appressed, on the upper whorls rudely nodulous; spiral sculpture in front of the fasciole on the spire of five or six strong cords with narrower interspaces, overriding the ribs; the cords cover the last whorl, feebler on the periphery, coarser on the base; there are also faint spiral striae here and there; axial sculpture on the upper part of the spire 14 or 15 strong rounded ribs with wider interspaces, feebler on the penultimate, obsolete on the last whorl; aperture ovate, anal sulcus conspicuous, shallow; outer lip thin, simple, inner lip smooth, canal short, wide, not recurved. Height of shell, 27; of last whorl, 16; diameter, 10 mm. Cat. No. 203670, U.S.N.M.

Range.—San Diego, California; collected by the late C. W. Gripp.

Verging toward *Clathrodrillia*, but nearer to such species as *Moniliopsis cancellata* Carpenter.

MONILIOPSIS FANCHERAE Dall.

Plate 8, fig. 3.

Mangilia fancherae DALL, Proc. Biol. Soc. Wash., vol. 16, p. 172, Dec., 1903.

Though so small this is allied to the larger species here referred to as *Moniliopsis* by its sculpture and the presence of an operculum, which was lost in the specimen originally described.

Range.—Santa Barbara Channel, California, to Point Abreojos, Lower California.

MONILIOPSIS RHINES Dall.

Plate 8, fig. 5.

Drillia cancellata CARPENTER, Proc. Acad. Nat. Sci. Phila. for 1865, p. 63, 1865; not of J. Sowerby, 1827.

Surcula rhines DALL, Proc. U. S. Nat. Mus., vol. 24, No. 1610, p. 248, June 16, 1908.

Range.—Puget Sound to San Diego, California.

MONILIOPSIS OPHIODERMA Dall.

Pate 12, fig. 5.

Pleurotoma inermis HINDS, Voy. *Sulphur*, Moll., p. 16; Proc. Zool. Soc. London, p. 37, 1843; Zool., pl. 5, fig. 7, 1844; not of Partsch, 1842.

Surcula ophioderma DALL, Proc. U. S. Nat. Mus., vol 34, No. 1610, p. 247, June 16, 1908.

Range.—San Pedro to Ballenas Lagoon, Lower California.

MONILIOPSIS INCISA Carpenter.

Plate 12, fig. 7.

Drillia incisa CARPENTER, Proc. Acad. Nat. Sci. Phila. for 1865, p. 62, 1865; not *Pleurotoma incisa* of Reeve, 1843.

Range.—Virago Sound, British Columbia, to San Pedro, California. Differs from *inermis* only by deeper and coarser grooving.

MONILIOPSIS HALCYONIS Dall.

Plate 8, fig. 1.

Turris (*Surcula*) *halcyonis* DALL, Proc. U. S. Nat. Mus., vol. 34, No. 1610, p. 248, June 16, 1908.

Range.—Monterey to San Diego, California.

SUAVODRILLIA WILLETTI, new species.

Shell small, white, with a pale operculum with apical nucleus; nuclear whorls translucent white, glassy, inflated, about one and a half in number, then gradually passing into the reticulate sculpture of the five or six subsequent turns; suture appressed with one or two close-set prominent spiral threads in front of it; whorls sloping forward flatly from these threads to an angle at the shoulder forming the periphery, this part of the whorl minutely spirally threaded; other spiral sculpture of (on the base about five) strong threads with wider interspaces containing minor threads all merging toward and on the canal into a series of subequal close-set threads; the anal fasciole has its deepest part at the shoulder angle, but the arcuate incremental lines on the whorl behind the angle indicate that it was when complete wide and shallow; axial sculpture of (on the penultimate whorl about 16) strongly protractive short ribs starting at the shoulder, which they slightly nodulate, and reaching to the suture, but obsolete on the last whorl and not reaching much beyond the periphery; outer lip thin, sharp; inner lip erased; pillar short, obliquely attenuated in front; canal short, distinct, slightly recurved. Height of shell, 10; of last whorl, 5; diameter, 4.5 mm. Cat. No. 216409, U.S.N.M.

Range.—Forrester Island, southeastern Alaska, G. Willett.

This shell belongs to the group of which "*Drillia*" *kennicottii* Dall, is the most conspicuous example and which serves as the typical species.

BELLASPIRA MELEA, new species.

Plate 19, fig. 8.

Shell stout, rose pink, with a whitish band in front of the suture, with a blunt smooth nucleus of about one whorl and about five subsequent whorls; suture appressed, obscure, spiral sculpture apparently absent; axial sculpture of (on the last whorl six) strong, stout, wavelike ribs, continuous up the spire, with wide interspaces, and practically vertical; the surface appears to be smooth but as the specimen is slightly beach worn some minute sculpture may have disappeared; the suture is undulated by the ribs, there is no anal fasciole perceptible; anal sulcus narrow, short, with a subsutural callus in front of it; outer lip thin, sharp, with a marked varicose swelling behind it; there are no internal lirae; inner lip callous, smooth;

pillar very short, stout, and straight; canal hardly differentiated from the aperture but deeply cut; height of shell, 12; of last whorl, 7.5; diameter, 5 mm. Cat. No. 15952, U.S.N.M.

Range.—Panama, Col. E. Jewett.

This is a very solid little shell and of a very attractive color. It is a typical *Bellaspira.*

? HAEDROPLEURA MELITA, new species.

Plate 24, fig. 7.

Shell small, slender, waxen white, with an obscure purple band in front of the suture and the region of the canal dark purple, when fresh; nucleus of two and a half gradually enlarging whorls, the first smooth, the last more or less axially minutely ribbed, and five subsequent whorls; axial sculpture of (on the last whorl) eight rather sharp ribs extending from the suture (which they undulate) to the region of the canal and continuous up the spire in a direct line with somewhat wider interspaces; suture distinct, appressed; spiral sculpture of fine uniform evenly spaced rounded threads, not swollen where they cross the ribs, a single thread at the shoulder is more prominent but not larger than the others, from which and from the suture it is separated by a space devoid of the spiral sculpture which elsewhere covers the surface; the ribs are shortly arcuate when passing over the otherwise obscure anal fasciole, and the depressions between them, the suture and the shoulder are markedly excavated; aperture narrow, anal sulcus conspicuous, rounded not deep; outer lip strongly varicose, not internally lirate, inner lip smooth, pillar short, straight, canal short, hardly differentiated from the aperture. Height of shell, 5.2; of last whorl, 3; diameter, 2 mm. Cat. No. 266436, U.S.N.M.

Range.—Agua Verde Bay, Gulf of California, Dr. Paul Bartsch.

The shell, though fresh, is without the soft parts, and therefore it can not be determined whether it is operculate or not.

CRYPTOGEMMA POLYCASTE, new species.

Plate 9, figs. 4, 7.

Shell white, with a pale olivaceous periostracum, and five whorls exclusive of the (lost) nucleus, rather slender and moderately rounded except for a single strong peripheral keel which marks the deepest part of the anal sulcus; suture distinct, not appressed, with a feebly indicated flattish area between it and the posterior edge of the anal fasciole, which between the keel and the flattening is slightly impressed; there is no other spiral sculpture and the axial sculpture consists mostly of moderately prominent incremental lines; anal sulcus deep and wide; outer lip thin, prominently arcuately produced; inner lip smooth, pillar very short, gyrate; axis pervious; canal pro-

duced, narrow, slightly recurved. Height of shell, 14; of last whorl, 9; diameter, 5.5 mm. Cat. No. 212332, U.S.N.M.

Range.—Station 3346, off Tillamook Bay, Oregon, in 786 fathoms, ooze, bottom temperature 37.3° F. U. S. Bureau of Fisheries.

CRYPTOGEMMA CHRYSOTHEMIS, new species.

Plate 11, fig. 2.

Shell short-fusiform, white, with a pale olive periostracum, the tip eroded, with six or more subsequent whorls; the suture distinct, the anal sulcus shallow, somewhat removed from the suture, the fasciole narrow, depressed; spiral sculpture of a low blunt peripheral keel, somewhat undulated on the earlier whorls with occasional traces of minor spiral threads; the entire surface is more or less obliquely granulose or minutely vermiculate; axial sculpture only of feeble incremental lines; outer lip thin, sharp, produced; inner lip erased; pillar short, obliquely attenuated in front; canal short, wide, not recurved; axis not pervious. Height of (eroded) specimen, 16.5; of last whorl, 11; diameter, 7.5 mm. Cat. No. 208908, U.S.N.M.

Range.—Station 4405, between San Clemente and Santa Catalina Islands, California, in 654 to 704 fathoms, mud, temperature 39°.4 F. U. S. Bureau of Fisheries.

CRYPTOGEMMA CALYPSO, new species.

Plate 9, fig. 8.

Shell small, the nucleus always eroded, whitish with a dark dull olivaceous periostracum and about five remaining whorls; suture appressed, with a broad smooth ridge in front of it and behind the excavated anal fasciole; spiral sculpture in front of the shoulder of fine even close-set equal threads, covering the surface, including the canal; axial sculpture of feeble incremental lines arcuate on the fasciole and antesutural ridge, also of narrow low sigmoid ribs beginning and forming a shoulder in front of the fasciole and obsolete in front of the periphery, differing in strength in different individuals and averaging fourteen on the last whorl; anal sulcus wide and deep, rounded; outer lip thin and sharp, much produced; inner lip with a thin layer of callus; pillar straight, short, obliquely attenuated in front; axis impervious; canal distinct, wide, hardly recurved. Height of (decollate) shell, 11; of last whorl, 7; diameter, 4.7 mm. Cat. No. 214067, U.S.N.M.

Range.—Station 2923, off San Diego, California, in 822 fathoms, mud, temperature at bottom 39° F. U. S. Bureau of Fisheries.

CRYPTOGEMMA CYMOTHOË, new species.

Plate 9, fig 3.

Shell much resembling the preceding species, from which it differs by having the anal fasciole striated spirally, the surface in front of

the shoulder without spiral sculpture and minutely vermiculate, the ribs more knob-like, shorter, and averaging about 12 on the last whorl; whorls about six in number, the apex always eroded. Height of (decollate) shell, 9; of last whorl, 6.5; diameter, 5 mm. Cat. No. 214067*a*, U.S.N.M.

Range.—Station 2923, off San Diego, California, in 822 fathoms, mud, temperature at bottom 39° F. U. S. Bureau of Fisheries.

CRYPTOGEMMA QUENTINENSIS, new species.

Plate 9, fig. 9.

Shell small, solid, white under an olivaceous periostracum, having five (decollate) whorls, suture distinct, bordered by a rounded ridge on each side; surface dull; spiral sculpture of a prominent nodulous peripheral ridge which is the anal fasciole, with two smaller ridges in front of it with wider interspaces; in front of the first of these the suture is laid; the space between this and the second is more or less channeled, but these two ridges are not nodulous; in front of these four or five obscure threads appear on the canal; axial sculpture of strong retractive wrinkles at the suture, which become arcuate nodulous riblets on the fasciole and dwindle protractively in front of it; there are also more or less obvious incremental lines; aperture moderate, simple, the axis pervious, the columella short, attenuated in front; canal short, slightly recurved, operculum narrow, with apical nucleus. Height of shell, 12; of last whorl, 9; diameter, 5 mm. Cat. No. 209417, U.S.N.M.

Range.—Off Cape San Quentin, Lower California, in 359 fathoms.

CRYPTOGEMMA ANTIGONE, new species.

Plate 11, fig. 4.

Shell solid, white, with an olivaceous periostracum, spire badly eroded, short, indicating a total of five whorls exclusive of the nucleus, the last whorl and a half alone retain their normal condition; suture distinct, not appressed; anal fasciole narrow, constricted, separated from the suture by an obscure ridge; in front of the fasciole is an undulated rounded ridge from which extend obliquely protractive obscure riblets more or less obsolete on the last whorl, probably stronger and more distinct on the spire when not eroded; there is also very obscure spiral grooving with much wider interspaces on the base; the entire surface is minutely irregularly vermiculate; aperture narrow; anal sulcus shallow, rounded, close to the suture; outer lip thin, sharp, moderately produced; inner lip erased, pillar short, white, obliquely attenuated in front; canal short, wide, hardly differentiated. Height of (decollate) shell, 23; of last whorl, 18; diameter, 10 mm. Cat. No. 214066*b*, U.S.N.M.

Range.—Station 2922, off San Diego, California, in 822 fathoms, mud, bottom temperature 39° F. U. S. Bureau of Fisheries.

This shell resembles a *Borsonella* so much that I was not satisfied of its true position until by grinding off part of the back the pillar was shown to be quite destitute of plication.

CRYPTOGEMMA ADRASTIA, new species.

Plate 19, fig. 2.

Shell white, with a thin, pale olive periostracum, the apex invariably eroded, and the subsequent whorls, eight or more, polished and faintly showing incremental lines; suture inconspicuous, the anterior margin sometimes raised like a small cord; spiral sculpture of a strong, sometimes nodulous or undulated peripheral keel, rather nearer the succeeding suture than to the preceding one, the latter space occupied by the slightly concave anal fasciole; axial sculpture only of arcuate incremental lines; base rounded; aperture narrow, outer lip thin, sharp, produced, internally smooth; anal sulcus wide and shallow, with no parietal nodule; inner lip erased; pillar smooth, twisted, not pervious, attenuated obliquely toward the rather long, slightly recurved canal. Height of decollate specimen of about five whorls, 16; of last whorl, 11.7; diameter, 6.25 mm. Cat. No. 226154, U.S.N.M.

Range.—Station 3670, Monterey Bay, California, in 581 fathoms, mud, temperature 37.8° F.; U. S. Bureau of Fisheries.

ANTIPLANES AGAMEDEA, new species.

Plate 24, fig. 2.

Shell small, white, covered with an olivaceous periostracum, with more than five whorls, apex eroded, the periphery with a rounded keel; spiral sculpture of a thickened flattish ridge in front of the channeled suture, and obscure spiral threading on the impressed anal fasciole and base, the canal smooth; axial sculpture of fine incremental lines more or less reticulating the spirals and arcuate over the fasciole, the peripheral keel on the spire nearer the succeeding than the preceding suture; aperture elongate, the outer lip thin, smooth within, arcuately produced in front of the fasciole; inner lip erased, pillar short, solid, obliquely attenuated in front, straight. Height of four whorls, 10.5; of last whorl, 8; diameter, 5 mm. Cat. No. 211759, U.S.N.M.

Range.—Station 2936, off Cape San Quentin, Lower California, in 359 fathoms, mud, bottom temperature 49° F. U. S. Bureau of Fisheries.

ANTIPLANES KAMCHATICA, new species.

Plate 10, fig. 1.

Shell sinistral, large, coarse, with a shining brown periostracum over a yellowish substratum, the suture distinct, the spire acute. the

whorls moderately rounded; axial sculpture only of sigmoid lines of growth, with six whorls exclusive of the nucleus and about a whorl and a half of the apex which are missing; spiral sculpture of fine close subequal striations with slightly wider interspaces, covering the whole surface; aperture wide, the outer lip sinuous, simple, the anal sulcus shallow, the canal wide and short. Height of shell, 51; of last whorl, 32; diameter, 27 mm. Cat. No. 225255, U.S.N.M.

Range.—Western Bering Sea and the southeast coast of Kamchatka in 100 fathoms, pebbly bottom, temperature 31.7° F. U. S. Bureau of Fisheries steamer *Albatross*.

This is the largest species of the genus and follows the rule that the species of the Asiatic side of Bering Sea are larger and coarser than their analogues of the American shore.

ANTIPLANES BULIMOIDES, new species.

Plate 11, fig. 7.

Shell elongate, decollate, whorls six or more, four distinctly remaining, suture distinct, not appressed, whorls moderately convex, smooth, with a pale polished greenish periostracum over a white substratum, in spots minutely granulose, apparently from some wrinkling of the periostracum; anal sulcus wide, shallow, hardly forming a fasciole; outer lip thin, sharp, moderately produced; inner lip with a thin white layer of callus; pillar straight, with an anterior oblique attenuation; canal wide, hardly differentiated; length of three complete whorls, 31; of last whorl, 23; diameter at apex, 5; maximum diameter, 15 mm. Cat. No. 111051, U.S.N.M.

Range.—Station 4772, on Bowers Bank, Bering Sea, in 344 fathoms, sand, bottom temperature 38.1° F. U. S. Bureau of Fisheries.

The bulimoid shape and glistening greenish periostracum make this species quite unique.

ANTIPLANES LITUS, new species.

Plate 11, fig. 1.

Shell slender, white, acute, with seven or eight moderately convex whorls separated by a very distinct suture; nucleus swollen, twisted, of two whorls, the second spirally threaded; on about three of the subsequent whorls these threads are developed into two or three major cords between the periphery and the suture, becoming on later whorls obsolete, or this sculpture in other specimens may be obsolete; there is also a semiobsolete fine spiral striation covering the whole surface and somewhat stronger on the canal; there is no axial sculpture; aperture narrow, anal sulcus feeble, close to the suture hardly forming a fasciole; outer lip thin, slightly produced; inner lip erased; pillar straight, canal short, wide. Height of shell, 16; of last whorl, 9; diameter, 5 mm. Cat. No. 206602, U.S.N.M.

Range.—Station 3194, off Esteros Bay, California, in 92 fathoms, sand, temperature 45.9° F. U. S. Bureau of Fisheries.

ANTIPLANES ABARBAREA, new species.

Plate 9, fig. 5.

Shell whitish, acute, with one globular nuclear and six and a half subsequent, well-rounded whorls; suture distinct, not appressed; spiral sculpture of faint obscure grooves with wider interspaces over the whole spire but obsolete on the last whorl, and a series of faint irregular peripheral nodulosities on the upper part of the spire; axial sculpture of rather coarse, irregular incremental lines, retractively arcuate in front of the suture, though there is no distinct fasciole; aperture elongate, anal sulcus close to the suture, rather deep; outer lip thin, smooth inside; inner lip erased; pillar straight, smooth, attenuated in front; canal short, wide, nearly straight. Height of shell, 21.5; of last whorl, 13.5; diameter, 8 mm. Cat. No. 224393, U.S.N.M.

Range.—Station 2954, off Santa Rosa Island, California, in 55 fathoms, shelly bottom, temperature 55.4° F. U. S. Bureau of Fisheries.

This specimen, though complete, has lost its periostracum and the nucleus is slightly eroded.

ANTIPLANES BRISEIS, new species.

Plate 22, fig. 1.

Shell elongate, acute, white, covered with a very pale olivaceous periostracum, with a blunt swollen nucleus of about a whorl and a half (eroded) and eight subsequent rather flattish whorls; suture obscure, appressed; spiral sculpture of one or two feeble flattish cords between the periphery and the succeeding suture on the spire, and on the last whorl about twice as many more or less obsolete; axial sculpture of rather prominent, deeply arcuate incremental lines; anal fasciole wide, not impressed, the deepest part of the sulcus near the periphery; aperture narrow, outer lip thin, sharp, much produced; inner lip and pillar erased, the latter short, straight, obliquely attenuated in front; canal distinct, produced, straight. Height of shell, 18; of last whorl, 10; diameter, 5 mm. Cat. No. 212329, U.S.N.M.

Range.—Station 3179, off Drakes Bay, California, in 30 fathoms, mud, temperature 50° F. U. S. Bureau of Fisheries.

ANTIPLANES HYPERIA, new species.

Plate 9, fig. 6.

Shell with more than six hardly rounded whorls (decollate), white, with a dark olive periostracum, the base white; suture appressed, distinct, the whorl in front of it constricted; spiral sculpture of (on the last whorl) a sharp thread or low keel above the periphery, two

more at the periphery; on the anterior one the suture is laid and it also forms the anterior boundary of the dark coloration; on the base are about five less conspicuous threads; all these have much wider interspaces; axial sculpture of moderately conspicuous incremental lines; anal sulcus wide and extremely shallow, the deepest portion at the posterior keel; there is no well defined fasciole; aperture short and wide, outer lip thin, only slightly produced in front of the sulcus; inner lip erased; pillar very short; canal very short and wide, but distinct, slightly recurved and with an inconspicuous siphonal fasciole. Height of five whorls, 12; of last whorl, 7; diameter of decollation, 1.7; of last whorl, 4.5 mm. Cat. No. 212329*a*, U.S.N.M.

Range.—Station 3179, off Drakes Bay, California, in 30 fathoms, mud, bottom temperature 50° F. U. S. Bureau of Fisheries.

This form might be taken for a variety of *A. brisis*, but is distinguished by its more emphatic and somewhat different sculpture, its white base, and the short pillar and canal. The anal sulcus is much more shallow and the outer lip less produced.

ANTIPLANES AMYCUS, new species.

Plate 11, fig. 5.

Shell white, covered with a brownish olive periostracum; with five or more moderately rounded whorls exclusive of the (lost) nucleus; suture distinct with a wide rounded ridge in front of it, forming the posterior boundary of the anal fasciole; spiral sculpture of a few obscure threads on the fasciole and in front of the shoulder 8 or 9, on the last whorl 15 to 18 flattish, rather close-set threads smaller and closer anteriorly and absent from the canal; axial sculpture of more or less distinct incremental lines, and on the upper spire of about 15 very oblique anteriorly protracted riblets chiefly visible at the shoulder and obsolete on or entirely absent from the last two whorls; anal sulcus wide, deep, rounded, the fasciole slightly impressed; outer lip thin, sharp, arcuately produced; inner lip erased, pillar short, white, obliquely attenuated in front; canal short, wide, distinct, slightly recurved. Height of four whorls, 21.5; of last whorl, 15; diameter at decollation, 3; of last whorl, 9.5 mm. Cat. No. 226163, U.S.N.M.

Range.—Station 3670, in Monterey Bay, California, in 581 fathoms, mud, bottom temperature 37.8° F. U. S. Bureau of Fisheries.

ANTIPLANES SANTAROSANA Dall.

Plate 11, fig. 3.

Pleurotoma (*Antiplanes*) *santarosana* DALL, Proc. U. S. Nat. Mus., vol. 24. No. 1264, p. 515, March, 1902.

Range.—Off Santa Rosa Island, California, in 53 fathoms, sand.

ANTIPLANES AMPHITRITE, new species.

Plate 9, fig. 1.

Shell white, covered with a pale olivaceous periostracum, of five or more well-rounded whorls exclusive of the (lost) nucleus, having a rounded shoulder and distinct not appressed suture; axial sculpture of, on the spire, obscure nodulations at the shoulder (about 15 on the penultimate whorl) which do not form ribs and are absent from the last whorl; incremental lines fine but obscure; beside these there are minute, anteriorly obliquely retractive lines somewhat microscopically reticulated by the lines of growth; there is no spiral sculpture except on some specimens a few obsolete lines on the base; anal sulcus shallow, slightly removed from the suture, the fasciole lightly impressed on the last whorl; aperture narrow, the outer lip thin, sharp, arcuately produced; inner lip erased, pillar white, solid straight, anteriorly obliquely attenuated; canal wide, straight, distinct. Height of five whorls, 13.5; of last whorl, 10; diameter, 6mm. Cat. No. 209953, U.S.N.M.

Range.—Station 4415, off Santa Barbara Island, California, in 638 fathoms, muddy bottom; U. S. Bureau of Fisheries. Also a variety *beroë* at Station 2923 off San Diego, California, in 822 fathoms, mud, bottom temperature 39°.

ANTIPLANES AMPHITRITE BEROË, new variety.

The variety differs in being larger, with the suture appressed, the fasciole close to it, and bearing three or four spiral grooves; height of four whorls, 19; of last whorl, 14; diameter at decollation, 2.5; of last whorl, 9 mm. Cat. No. 21466*a*, U.S.N.M.

ANTIPLANES THALAEA Dall.

Plate 11, fig. 6.

Pleurotoma (*Antiplanes*) *thalaea* DALL, Proc. U. S. Nat. Mus., vol. 24, No. 1264, p. 514, March, 1902.

Range.—Off San Luis Obispo, California, in 252 fathoms, and north to the Aleutian Islands.

BORSONELLA BARBARENSIS, new species.

Plate 12, fig. 6.

Shell solid, of six or more whorls, the apex decollated, the periostracum greenish olive over a white substratum, yellowish on the pillar; suture distinct with a convex spiral band between it and the fasciole; spiral sculpture of a pronounced keel in front of the fasciole, on the upper part of the spire this keel may be more or less undulated; in front of the keel the surface is retractively somewhat irregularly obliquely grooved, with wider flattish interspaces upon which

is a minute protractively looped sculpture giving a vermicular aspect to the surface under a magnifier; aperture ovate, simple, the outer lip thin and sharp, the anal sulcus wide and moderately deep, the pillar straight, attenuated in front, the plait hidden behind it, the canal short and wide, the operculum missing. Height of shell, 29; of last whorl, 20; diameter, 12 mm. Cat. No. 96841, U.S.N.M.

Range.—Off Santa Barbara Island, California, in 302 to 614 fathoms, sand, bottom temperature 41.4° F. U. S. Bureau of Fisheries steamer *Albatross*.

In these species the plait on the pillar is generally hidden behind the pillar so as to be invisible from a front view of the aperture.

BORSONELLA NYCHIA, new species.

Plate 12, fig. 2.

Shell white with an olivaceous periostracum, biconic, acute, the nucleus (eroded) of one or two whorls, with about six subsequent whorls, rapidly enlarging, flatly descending from a distinct, not appressed suture to the periphery and with the last whorl conically attenuated in front; spiral sculpture of an obscure thickening in front of the suture, fine rather irregular striae thence to the periphery, crossed obliquely by irregular scratches, a prominent angle at the periphery which on the spire is just behind the suture, and on the last whorl is ornamented with nine or ten prominent nodules with wider interspaces; on the base the striae are coarser and more irregular, the interspaces assuming the form of (about 15) flattish threads, sparser on the canal; axial sculpture of fine incremental lines arcuate on the anal fasciole; aperture elongate triangular, the anal sulcus very wide and shallow, outer lip thin, sharp, smooth within, arcuate in front of the periphery; inner lip erased, pillar solid, short with a single plication near the body, attenuated in front, straight; canal hardly differentiated, somewhat produced. Height of shell, 12; of last whorl, 8; diameter, 5.5 mm. Cat. No. 208891, U.S.N.M.

Range.—Station 4361, off Point Loma, California, in 101 fathoms, sandy bottom; U. S. Bureau of Fisheries.

BORSONELLA OMPHALE, new species.

Plate 12, fig. 4.

Shell slender, acute, with eight flattish whorls exclusive of the (lost) nucleus, white covered by a very light olive gray periostracum; suture distinct, fasciole hardly impressed; spiral sculpture of obscure striae, sparser on the base; axial sculpture of incremental faint lines arcuate on the anal fasciole; aperture narrow, anal sulcus wide, moderately deep; outer lip thin, prominently arcuate in front of the periphery; inner lip erased, pillar strong with a single fold near the body; attenuated in front; canal short. Height of shell, 16; of last whorl, 10; diameter, 6 mm. Cat. No. 209174, U.S.N.M.

Range.—Station 4309, off Point Loma, California, in 78 fathoms, sand, U. S. Bureau of Fisheries.

BORSONELLA NICOLI, new species.

Plate 12, fig. 1.

Shell solid, white, covered with a pale straw-colored periostracum, of eight whorls exclusive of the (lost) nucleus, the suture distinct with a slightly swollen margin; axial sculpture of (on the penultimate whorl about nine) nodular ribs, peripheral on the spire, becoming obsolete on the last whorl, beginning in front of the fasciole and obscure beyond the periphery; spiral sculpture of fine striae, visible only in occasional spots, the fasciole somewhat constricted; beside this there are faint traces of vermicular sculpture visible under a glass, reminiscent of the sculpture in *B. barbarensis;* aperture narrow, anal sulcus moderately deep, outer lip thin, arcuate, body and pillar smooth, the plait hidden behind the columella which is attenuate in front, canal short and wide. Height of shell, 22; of last whorl, 13; diameter, 8 mm. Cat. No. 198925, U.S.N.M.

Range.—Southwest of San Nicolas Island, California, in 158 fathoms. U. S. Bureau of Fisheries Steamer *Albatross.*

BORSONELLA RHODOPE, new species.

Plate 12, fig. 3.

Shell with seven or more whorls exclusive of the (lost) nucleus, white covered with a pale olivaceous periostracum, suture distinct, not appressed; axial sculpture of rather strong irregular incremental lines; spiral sculpture of a thickened band between the suture and the somewhat constricted anal fasciole; at the shoulder a blunt angulation, in front of which are two obscure threads followed by a more distinct thread on which the suture is laid; on the last whorl in front of the angulation are about 18 threads growing smaller and more close-set anteriorly; there is no siphonal fasciole; aperture rather narrow, anal sulcus shallow rounded, outer lip thin, arcuate, sharp; inner lip erased, pillar straight, obliquely attenuated in front; canal rather wide, not recurved. Height of shell, 19; of last whorl, 11; diameter, 7 mm. Cat. No. 212361, U.S.N.M.

Range.—Station 2953, off Santa Rosa Island, California, in 82 fathoms, gray sand and broken shell. U. S. Bureau of Fisheries.

Genus LORA Gistel.

Since the name *Bela* (Leach MS.) Gray, 1847, has been shown to be synonymous with *Mangelia* Risso, having the same type, the question arises what name shall be adopted in its place? The name *Pleurotomina* was proposed by Gray in 1838[1] as a group name,

[1] Ann. Nat. Hist., vol. 1, p. 28, 1838.

apparently of subfamily value, including various Pleurotomids, among them *Drillia* Gray. Nine years later in some catalogues of local faunas[1] this name was used in a generic sense by Beck for an undescribed species said (p. 115) only to be "nahe turric. Mont." Earlier in the same work the name is cited as of Gray, as if it covered all small Pleurotomids. Not until 1869 was Beck's species described by Mörch[2] under the name of "*Pleurotoma* (*Ischnula*) *impressa* Beck," from Bell Sound, Spitsbergen. As neither genus nor species was described in 1847, the opinion prevails that *Pleurotomina* can not be adopted. The next name is *Lora* Gistel[3] proposed with the sole species *Defrancia viridula* O. Fabricius, which must be taken as type. This species, as Fabricius's description indicates, is a *Bela;* the type-specimen at Copenhagen confirms this opinion. How it has come to be regarded as an *Admete* is not easy to understand.

Subsequently Mörch[4] proposed for part of the Belas of authors the name *Oenopota*, rendered *Onopota* by H. and A. Adams. Under the circumstances *Lora* seems entitled to adoption.

LORA PITYSA, new species.

Plate 16, fig. 7.

Shell small, translucent white, with a one sided subglobular smooth nucleus of a whorl and a half, and about four subsequent whorls; suture distinct, anal fasciole sloping to a corded shoulder; spiral sculpture begins by two strong cords, one of which marks the shoulder and to these are added by intercalation until the penultimate whorl has four and the last whorl fourteen, not counting the threads on the canal; these are reticulated by axial cords of similar size which do not form ribs or nodes though the posterior cord at the shoulder is slightly undulated; anal sulcus obscure, aperture simple, inner lip erased, canal short. Height of shell, 5.5; of last whorl, 3.5; diameter, 2 mm. Cat. No. 209851, U.S.N.M.

Range.—From Point Pinos to San Diego, California, in 62 to 680 fathoms. U. S. Bureau of Fisheries steamer *Albatross.*

? LORA HALITROPA, new species.

Plate 16, fig. 6.

Shell small, white, with a subglobular smooth nucleus of a whorl and a half, followed by four and a half subsequent whorls; suture appressed, undulated by the ends of the ribs, anal fasciole obscure; axial sculpture of (on the last whorl 14) stout rounded ribs which extend to the suture which they undulate, and, with some loss of

[1] Amtl. Ber. Deutsche Naturf. u. Aertze, Kiel, 1847.

[2] Mém. Soc. Mal. de Belgique, vol. 4, p. 21, 1869.

[3] Naturg. Thierr., p. IX, 1848.

[4] Yoldi Catalogue, vol. 1, p. 78, 1852, no type cited or description given. *Pleurotoma pleurotomaria* first species, which I now select as type.

emphasis, to the canal; the interspaces are equal or narrower; spiral sculpture begins at the shoulder and consists of very minute equal, regular close-set flattish threads which are less conspicuous on the ribs and, in the interspaces, are segmented by the incremental lines; aperture simple, inner lip erased, canal short, proximately constricted, marking a perceptible siphonal fasciole. Height of shell, 6; of last whorl, 4; diameter, 2.6 mm. Cat. No. 96216, U.S.N.M.

Range.—Magellan Strait, in 61 fathoms, sand bottom temperature 48° F.

There is a possibility that this shell may belong to another genus, but in the absence of the operculum and soft parts, this can not be decided.

LORA BRACHIS, new species.

Plate 7, fig. 3.

Shell small, short, stout, blunt, of about four and a half whorls; anal fasciole sloping toward a carinate beaded shoulder, retractively wrinkled between the distinct suture and a nearly median thread; axial sculpture of (on the last whorl about 30) small, narrow, protractive equal ribs with subequal interspaces, obsolete on the base, each beginning at a bead on the carina; spiral sculpture of fine sharp equal and equidistant striae covering the shell in front of the carina, cutting minutely the summits of the ribs, with wider flattish interspaces; aperture rather wide, simple; canal short, deep, recurved. Height of shell, 4.5; of last whorl, 3; diameter, 3.3 mm. Cat. No. 96486, U.S.N.M.

Range.—Galapagos Islands in 812 fathoms, ooze, bottom temperature 38.4° F. U. S. Bureau of Fisheries steamer *Albatross.*

LORA ANTIPODA, new species.

Plate 19, fig. 1.

Shell small, whitish, elevated, with a smooth bulbous nucleus and about five shouldered whorls; suture distinct, slightly appressed, anal fasciole wide, sloping, concavely wrinkled; shoulder marked by a stout smooth slightly undulated cord in front of which are three or four smaller threads and beyond those still smaller close-set threadlets extending to the end of the canal; axial sculpture of (on the penultimate whorl about 14) protractively arcuate ribs with subequal interspaces, feebler on the last whorl and obsolete on the base; canal straight, rather long, aperture simple; the spiral sculpture does not nodulate the axial ribs and is most distinct in the interspaces. Height of shell, 5; of last whorl, 3; diameter, 2.4 mm. Cat. No. 209450, U.S.N.M.

Range.—Magellan Strait, in 61 fathoms, mud, bottom temperature 53.9° F. U. S. Bureau of Fisheries steamer *Albatross.*

LORA HEALYI, new species.

Plate 16, fig. 8.

Shell white, more or less discolored by ferruginous red (probably adventitious) with five and a half rounded whorls, a subglobular smooth nucleus forming one and a half of these: spiral sculpture of (on the penultimate whorl 6 or 7, on the last whorl about 14) coarse rather irregular cords with narrower channelled interspaces, the cords more or less nodulated by incremental lines and on the spire by obscure ribbing: suture distinct, aperture narrow, simple: pillar white, erased, canal short, straight. Height of shell, 15; of last whorl, 10; diameter, 7 mm. Cat. No. 223908, U.S.N.M.

Range.—Arctic Ocean north of Bering Straits.

Named in honor of the late Capt. M. A. Healy, of the United States Revenue Marine, a frequent contributor to the national collection.

LORA POPOVIA, new species.

Plate 14, fig. 8.

Shell white with straw-colored periostracum, six shouldered whorls, a subglobular small nucleus, and distinct suture: spiral sculpture of (on the upper whorl four or five) rounded threads, between the shoulder and the succeeding suture, the threading obsolete on the last whorl or reduced to fine striation on the base and canal: axial sculpture on the spire of about 16 short rounded ribs swollen at the shoulder and reaching the succeeding suture, but fainter on the last whorl and absent from the base: aperture simple, pillar white erased, canal short, straight. Height of shell 13: of last whorl, 8: diameter 5.5 mm. Cat. 220883, U.S.N.M.

Range.—Bristol Bay, Bering Sea, to Monterey Bay, California.

LORA TENUILIRATA Dall.

Plate 15, fig. 4.

Bela tenuilirata DALL, Amer. Journ. Conch., vol. 7, p. 98, Nov. 1871.

? + *Bela simplex* G. O. SARS, 1878, not of Middendorff, 1849.

The original specimen of this species was quite young. I now figure the adult.

Range.—Point Barrow, Arctic Ocean, to the Shumagin Islands, Alaska.

LORA TENUILIRATA CYMATA, new variety.

Plate 16, fig. 4.

Shell resembling typical *tenuilirata*, but with a higher and more acute spire, and with 20 or more narrow axial riblets on the last whorl, obsolete on the base, and a single spiral thread at the shoulder. Height, 23; of last whorl, 17; diameter, 10.5 mm. Cat. No. 226186, U.S.N.M.

Range.—Nunivak Island, Bering Sea, to the Shumagin Islands,

LORA LAWRENCIANA, new name.

Plate 15, fig. 6.

Bela tenuilirata KRAUSE, Arch. f. Naturg, vol. 51, heft 3, p. 274, pl. 18, fig. 8, 1886; not of Dall, 1871.

Range.—Point Belcher, Arctic Ocean, to the Pribilof Islands, Bering Sea.

LORA MITRATA, new species.

Plate 16, fig. 1.

Shell resembling *tenuilirata cymata*, but with sharper sculpture, higher spire, shorter aperture, more gyrate pillar, and darker color, especially on the keel at the shoulder. Height of shell, 24; of last whorl, 16; diameter, 11 mm. Cat. No. 87857, U.S.N.M.

Range.—Port Clarence, Bering Strait, to the Shumagin Islands, Alaska.

LORA PAVLOVA, new species.

Plate 14, fig. 9.

Shell white, thin, and delicate, with six or more whorls, the nucleus eroded; spiral sculpture of fine striae with wider flat interspaces minutely cut into segments by close regular incremental lines, whorls subangulate at the shoulder; axial sculpture of sharp, sigmoid riblets (22 or more on the penultimate whorl) obsolete on the base and on most of the last whorl; anal sulcus wide, shallow; aperture simple, inner lip erased. Height of shell, 18.5; of last whorl, 12.5; diameter, 9 mm. Cat. No. 226200, U.S.N.M.

Range.—Station 3607, off the Pribilof Islands, Bering Sea, in 987 fathoms, mud, bottom temperature 35.9° F. U. S. Bureau of Fisheries steamer *Albatross*.

LORA CHIACHIANA, new species.

Plate 14, fig. 7.

Shell olive brown, with five whorls, the nucleus eroded, suture distinct; upper whorls with about 16 axial, rather rude, roughly sigmoid riblets crossing the whorls, obsolete on the latter half of the shell, the incremental lines irregular; spiral sculpture of almost obsolete fine spiral striae most evident on the last whorl, the interspaces flattish, wider, or subequal; aperture brownish, simple, pillar white, canal slightly recurved. Height of shell, 20; of last whorl, 14; diameter, 9 mm. Cat. No. 206207, U.S.N.M.

Range.—Chiachi Islands, Aleutian chain.

LORA ALITAKENSIS, new species.

Plate 15, fig. 7.

Shell thin, pale yellowish, with touches of reddish brown on the prominences, with about six whorls, the nucleus eroded, the suture

distinct; axial sculpture of (on the last whorl 14) sigmoid ribs which cross the whorls and reach the canal with subequal interspaces; spiral sculpture with narrow channeled grooves with wider flattish interspaces often divided by a central feebler groove, these cover the whole surface; aperture simple, inner lip erased, white; canal short, very slightly recurved. Height of shell, 20; of last whorl, 14; diameter, 9 mm. Cat. No. 222088, U.S.N.M.

Range.—Unimak Island, Aleutians, eastward to Alitak Bay, Kodiak.

LORA EQUATORIALIS, new species.

Plate 13, fig. 2.

Shell white, rather solid, with about six shouldered whorls, the apex eroded, the suture distinct, slightly constricted and appressed; axial sculpture of about 14 rounded ribs nearly reaching the canal, with subequal interspaces; incremental lines inconspicuous; spiral sculpture of uniform spiral grooves with wider flattish interspaces, cutting the tops of the ribs; aperture short, simple, inner lip callous, canal short, recurved. Height of shell, 13.5; of last whorl, 9; diameter, 6 mm. Cat. No. 97092, U.S.N.M.

Range.—Coast of Ecuador to Patagonia in 401 to 122 fathoms.

LORA PRIBILOVA, new species.

Plate 16, fig. 3.

Shell white with a strawcolored periostracum and about six roughly sculptured whorls, the apex eroded; suture distinct, axial sculpture of (on the last whorl 16) rounded narrow riblets crossing the whorls and obsolete on the base; spiral sculpture of (on the spire three, on the last whorl four) prominent rounded cords more or less nodose at the intersections with the ribs, and between the cords two or three fine threads and a few finer striae; the posterior cord forms a shoulder to the whorl; on the canal the cords and threads become more uniform; aperture simple, pillar erased. Height of shell, 12; of last whorl, 8; diameter, 5.5 mm. Cat. No. 225573, U.S.N.M.

Range.—Cape Lisburne, Arctic Ocean, south to Esteros Bay, California.

LORA INEQUITA, new species.

Plate 16, fig. 9.

Shell yellowish white, thin, of about six moderately rounded whorls, the nucleus eroded; suture distinct; spiral sculpture on the early whorls of two strong cords one on each side of the periphery, between which are first one, later two, and finally four smaller threads; the posterior cord gives the whorl a slight shoulder; on the last whorl in front of the anterior cord to the end of the canal are smaller, more or less alternate flattish cords close-set, the inter-

spaces wider on the canal; axial sculpture of (on the penultimate whorl about 20) rounded sigmoid ribs with wider or subequal interspaces, crossing the early whorls, becoming less evident on the later whorls, and obsolete on the base of the last whorl; the incremental lines are more or less evident; aperture narrow, simple; pillar white, erased, attenuated in front. Height of shell, 11; of last whorl, 7; diameter, 4 mm. Cat. No. 222238, U.S.N.M.

Range.—Plover Bay, Bering Sea, south to Boca de Quadra, Alaska.

LORA SURANA, new species.

Plate 14, fig. 6.

Shell thin, white, small, with about six whorls, the nucleus defective, the suture distinct; anal fasciole extending from the suture to a cord which forms a shoulder to the whorl, retractively loop-wrinkled; axial sculpture in front of the shoulder of numerous low narrow sigmoid riblets with subequal interspaces, obsolete on the base, on the spire crossing the whorls; spiral sculpture of somewhat unequal flattish threads with equal or wider interspaces, crossing the shell, not nodulous at the intersections; aperture simple, canal short, twisted, developing an evident siphonal fasciole; operculum normal. Height of shell, 9; of last whorl, 6; diameter, 4 mm. Cat. No. 206590, U.S.N.M.

Range.—From off Point Sur to off Point Pinos, California, in 292 to 398 fathoms, mud, bottom temperature 41° F.

LORA TABULATA Carpenter.

Plate 14, fig. 1.

Mangelia ? tabulata CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 15, p. 29, Jan., 1865.

Range.—Sitka, Alaska, to Monterey, California.

In fully adult specimens there is sometimes a thickening near the anterior end of the pillar which in some individuals approaches a fold, but is not carried into the interior on the pillar.

LORA NAZANENSIS, new species.

Plate 15, fig. 8.

Shell short-fusiform, white with a brown band in front of the suture and another on the base, or all white, with about five whorls and a very small blunt nucleus, suture distinct, whorls moderately rounded; axial sculpture of (on the penultimate whorl about 25) narrow crowded sigmoid ribs not passing the periphery but extending from the preceding suture with narrower interspaces; spiral sculpture of narrow grooves with wider interspaces, more close toward the base and on the spire cutting the summits of the ribs; aperture simple, pillar white, erased; canal short, straight. Height of

shell, 11; of last whorl, 8; diameter, 5.5 mm. Cat. No. 220327, U.S.N.M.

Range.—Nazan Bay, Atka Island, Aleutian Islands, in about 12 fathoms; a few worn specimens from Norton Sound may belong here.

LORA EXCURVATA Carpenter.

Plate 14, fig. 5.

Bela excurvata CARPENTER, Proc. Acad. Nat. Sci., Phila., for 1865, p. 63.

Range.—Bristol Bay, Bering Sea, to Puget Sound.

LORA KRAUSEI Dall.

Plate 15, fig. 3.

Bela krausei DALL, Proc. U. S. Nat. Mus., vol. 9, 1886, p. 301, pl. 4, fig. 4.

Range.—Port Etches, Alaska, in 15 fathoms, sand.

LORA MONTEREALIS, new species.

Plate 15, fig. 9.

Shell very similar to *L. surana*, but larger, with the same number of whorls, the ribs less numerous, more emphatic, with wider interspaces, and a less conspicuous cord at the shoulder. Height of shell, 12; of last whorl, 8; diameter, 5.3 mm. Cat. No. 226160, U.S.N.M.

Range.—Monterey Bay, in 581 fathoms, mud, bottom temperature 37.8° F. U. S. Bureau of Fisheries steamer *Albatross.*

LORA QUADRA, new species.

Plate 15, fig. 2.

Shell short and stout, white with about five whorls, the apex eroded, suture distinct, the anal fasciole narrow, excavated, finely spirally striated; axial sculpture of (on the last whorl about 18) stout nearly vertical ribs angulated at the edge of the fasciole, forming a narrow shoulder, but without a limiting cord, with usually narrower interspaces and obsolete on the base, the incremental lines not conspicuous; spiral sculpture of spiral grooves with much wider flat interspaces, the canal constricted, spirally threaded, very short; aperture simple, inner lip erased. Height of shell, 8; of last whorl, 6; diameter, 4.5 mm. Cat. No. 223606*a*, U.S.N.M.

Range.—Aleutian Islands to Puget Sound.

LORA DIEGENSIS, new species.

Plate 16, fig. 10.

Shell white with a pale brownish periostracum and five shouldered whorls, the nucleus eroded; suture distinct, anal fasciole narrow, spirally threaded, bounded in front by the angle of the shoulder; spiral sculpture of on the spire three to five subequal cords with equal interspaces, on the last whorl about 14 slightly swollen at the intersections; axial sculpture of (on the penultimate whorl about 24)

cord like riblets, beaded at the shoulder, obsolete on the base, the rectangular interstices marked; aperture simple, pillar erased, attenuated in front, canal well marked, straight. Height of shell, 8.5; of last whorl, 6; diameter, 4 mm. Cat. No. 209421 *a*, U.S.N.M.

Range.—Off San Diego, California, and south to Cape San Quentin, Lower California, in 112 to 822 fathoms.

LORA LOTTA, new species.

Plate 14, fig. 4.

Shell small, white, with a pale straw-colored periostracum, nucleus eroded, four whorls remaining, the general characters resembling those of *L. surana*, but the axial sculpture nearly obsolete, or quite absent from the last whorl, the shoulder less accented, and the canal straighter. Height of shell, 7.5; of last whorl, 6; diameter, 4 mm. Cat. No. 210725, U.S.N.M.

Range.—Queen Charlotte Islands, British Columbia, in 876 fathoms, mud, bottom temperature 36.5° F.

LORA KYSKANA, new species.

Plate 14, fig. 3.

Shell belonging to the group of *L. fidicula* Gould, but with looser and less regular sculpture, white, the nucleus defective, with about six shouldered whorls; suture distinct, anal fasciole obscure, undulated by the ends of the ribs, spirally striated; axial sculpture of (on the last whorl 14 or 15) rounded ribs with wider interspaces, prominent at the shoulder, crossing the whorls at the spire, obsolete on the base; spiral sculpture of numerous narrow channeled grooves with wider flattish interspaces, not nodulating the summits of the ribs; on the spire the interspaces are more cordlike, six or seven between the shoulder and the succeeding suture; aperture simple, inner lip erased, canal short, straight. Height of shell, 10.5; of last whorl, 7; diameter, 4.5 mm. Cat. No. 224286, U.S.N.M.

Range.—Aleutian Islands to Puget Sound.

LORA MIONA, new species.

Plate 14, fig. 2.

This is another species of the *fidicula* group, white, small, roundly shouldered with rather coarse sculpture on the spire, which becomes obsolete on the last whorl; axial sculpture of (on the penultimate whorl 13) rounded irregular ribs with subequal interspaces, the ribs nodulate by the intersection of three or four rather strong spiral cords with narrower interspaces; on the last whorl the ribs are obsolete and the spiral sculpture feebler, flatter, and with occasional intercalary smaller threads; anal fasciole and sulcus obscure, aperture narrow, inner lip erased, canal short. Height of shell, 8; of last whorl, 5; diameter, 3.5 mm. Cat. No. 252208, U.S.N.M.

Range.—Sitka, Alaska, to Puget Sound.

LORA HARPA Dall.

Mangilia (*Bela*) *plicifera* F. SCHMIDT, Mammut Exp., Mém. Imp. Acad. St. Petersburg, ser. 7, vol. 18, No. 1, pp. 57, 168, pl. 4, figs. 4, 5, 1872. Not of S. Wood, Crag Moll., p. 64, pl. 7, fig. 15, 1848 (as *Clavatula*).

Bela harpa DALL, Proc. U. S. Nat. Mus., vol. 7, 1884, p. 523; vol 9, 1886, p. 300, pl. 4, fig. 12.

Bela schmidti FRIELE, North Atlantic Exp., p. 10, pl. 8, fig. 6, 1886.

Bela turpa "Dall," FRIELE, North Atlantic Exp., p. 10, in footnote, err. typ. for *harpa*.

Range.—Arctic Ocean near Point Barrow and south to Queen Charlotte Sound, British Columbia. Quaternary of Novaia Zemlia (Schmidt). Spitsbergen (Friele). Kara Sea (Leche).

LORA REGULUS, new species.

Plate 15, fig. 1.

Shell small, white, slender, with predominant spiral sculpture, five whorls, the nucleus eroded; anal fasciole constricted, narrow, the suture inconspicuous, appressed; axial sculpture occasional faint traces of threadlike obsolete ribs; spiral sculpture of (on the penultimate whorl four or five, on the last whorl about nine) flattish, somewhat undulated spirals with irregular interspaces, usually wider on the last whorl, and on the canal finer close spiral threads; aperture narrow, inner lip erased, canal short, slightly recurved. Height of shell, 8; of last whorl, 5; diameter, 3 mm. Cat. No. 207262, U.S.N.M.

Range.—Off Point Reyes, California, in 61 fathoms, rocky bottom, temperature 48.5° F.

LORA IMPRESSA Mörch.

"*Pleurotomina* n. sp. nahe turric. Mont." BECK, Amtl. Ber. Deutscher Naturf. u. Aerzte, Kiel, 1847, p. 115.

Pleurotoma (*Ischnula*) *impressa* (Beck MS.) MÖRCH, Mém. Soc. Malac. de Belgique, vol. 4, p. 21, 1869.

Bela impressa LECHE, Nov. Zeml. Moll., p. 54, pl. 1, fig. 16.—KRAUSE, Arch. f. Naturg., vol. 51, heft 3, p. 278, 1886.

Range.—Arctic Ocean, near the Seahorse Islands, south to the Aleutians and eastward to St. Paul, Kodiak Island, Alaska. On the Atlantic side, Bell Sound, Spitsbergen, and Novaia Zemlia.

LORA LÜTKENI, new species.

Plate 16, fig. 5.

Shell small, white, with a minute smooth nucleus and five subsequent whorls; suture distinct, anal fasciole narrow, constricted, obscure; axial sculpture of (on the last whorl 26) narrow well-defined ribs, slightly peripherally prominent on the early whorls, with narrower interspaces, extending from suture to suture and on the last whorl to the canal, slightly protractively arcuate; there are also fine regular incremental lines; spiral sculpture of numerous fine sharp striae with subequal interspaces, which groove the surfaces of the

ribs and become threadlike on the canal; aperture narrow, inner lip erased, canal short. Height of shell, 8; of last whorl, 5; diameter, 3 mm. Cat. No. 220305, U.S.N.M.

Range.—Port Etches, Alaska, in 10 fathoms, mud; W. H. Dall.

Named in honor of the late Professor Lütken, of Copenhagen. It is a small member of the *L. harpa* group.

LORA SIXTA, new species.

Plate 16, fig. 12.

Shell small, white with a pale olivaceous periostracum, of five or more whorls (apex eroded); suture distinct; anal fasciole slightly excavated, sloping to a shoulder; axial sculpture of (on the last whorl about 20) narrow rounded ribs with subequal interspaces, obsolete on the base, slightly nodulose on the shoulder, supplemented by fine regular almost microscopic incremental lines; spiral sculpture hardly visible on the ribs, of feeble threads with wider flat interspaces, most evident toward the canal; aperture simple, inner lip erased, canal straight. Height of shell, 8; of last whorl, 6; diameter, 3.5 mm. Cat. No. 209235, U.S.N.M.

Range.—Off San Diego, California, in 640 fathoms, mud, bottom temperature 39° F. U. S. Bureau of Fisheries steamer *Albatross.*

LORA ALTHORPENSIS, new species.

Plate 16, fig. 11.

Shell waxen yellow, coarsely sculptured, small, of about six whorls, including one smooth nuclear turn; suture distinct, anal fasciole obscure, anal sulcus very feeble; spiral sculpture on the early whorls of two strong rows of nodules on the ribs, the cords connecting them less conspicuous; on the last whorl there are about 14 cords, but only that at the shoulder is conspicuous, the interspaces are narrower with an occasional intercalary thread; axial sculpture of (on the penultimate whorl about 20) narrow nearly vertical ribs with subequal interspaces reticulating the spirals, with deep interstices, but on the last whorl becoming obsolete; aperture narrow, inner lip erased, canal short, straight. Height of shell, 6.5; of last whorl, 4; diameter, 2.5 mm. Cat. No. 208558, U.S.N.M.

Range.—Port Althorp, Alaska, in Granite Cove, in about 12 fathoms, sand; W. H. Dall.

This species belongs to the group of *L. kyskana*, but is a much smaller shell.

LORA TENUISSIMA, new species.

Plate 15, fig. 5.

Shell thin, fragile, acute, whitish, with about six whorls, the nuclear whorl eroded; suture distinct, whorls evenly rounded; spiral sculpture of fine even equal close-set minute threads covering the whole

surface; axial sculpture of almost microscopic, even, regular incremental lines, and on the third whorl about 16 small sharp ribs crossing the whorl, with wider interspaces and becoming obsolete on the fourth whorl; anal sulcus shallow, aperture simple, inner lip erased, pillar attenuated in front, canal short, straight. Height of shell, 15; of last whorl, 11; diameter, 6 mm. Cat. No. 214207, U.S.N.M.

Range.—Chernoffski Harbor, Unalaska Island, Alaska, in 109 fathoms.

This species is remarkably distinct from most of the others described in this paper. Only one specimen was obtained. The operculum is shorter and broader than in most of the Loras.

LORA RUGULATA Troschel.

Plate 13, fig. 6.

Bela rugulata (Möller MS.) TROSCHEL, Geb. der Schnecken, 1866, vol. 2, p. 44, pl. 4, fig. 6.—G. O. SARS, Moll. reg. Arct. Norv., p. 230, pl. 23, fig. 6, 1878.—FRIELE, North Atlantic Exp., vol. 2, p. 3, pl. 7, figs. 1–7; pl. 9, figs. 1–12, 1886.

Range.—Bering Sea, from Plover Bay to the Aleutians and Kamchatka and south to Port Althorp, Alaska, in 16 to 69 fathoms, North Atlantic, Spitsbergen, Northern Norway, with several varieties. Friele unites with it *L. assimilis* G. O. Sars, and *L. gouldii* Verrill. The figured specimen is Cat. No. 222298, U.S.N.M.

LORA COLPOICA, new species.

Plate 16, fig. 2.

Shell resembling *L. tenuissima* in sculpture, but shorter, much more distinctly shouldered, and subangulate at the shoulder, with traces of axial sculpture carried on to the last whorl, but no distinct ribs on the early whorls as in that species. Height of shell, 11; of last whorl, 8.3; diameter, 6 mm. Cat. No. 214193, U.S.N.M.

Range.—Tillamook Bay, Oregon, in 786 fathoms, U. S. Bureau of Fisheries Steamer *Albatross*.

Subfamily MANGILIINAE.

PLEUROTOMELLA HERMINEA, new species.

Plate 3, fig. 6.

Shell of moderate size, gray with brown apex; nucleus eroded; with a total of eight whorls; suture distinct, preceded by an obscure thickened margin, not appressed; whorls descending flatly from the suture to the shoulder; axial sculpture of (on the last whorl 10 or 11) short, protractively oblique rounded ribs, extending on the spire from the shoulder to the succeeding suture, but on the last whorl not over the base; and obscure incremental lines arcuate on the anal fasciole; spiral sculpture on the spire of three or more threads, with

subequal interspaces, in the space between the periphery and the succeeding suture, and on the last whorl on the base about twenty flatter spirals with narrower interspaces; most of the threads are swollen where they pass over the ribs; aperture wide and short; anal fasciole deep and rounded, not quite adjacent to the suture; outer lip thin, produced, sharp; body erased; pillar short, gyrate, but the axis not pervious; canal distinct, short slightly recurved. Height of shell, 19; of last whorl, 12; diameter, 8 mm. Cat. No. 210544, U.S.N.M.

Range.—Station 4407, off Catalina Island, California, in 600 fathoms, ooze, U. S. Bureau of Fisheries.

PLEUROTOMELLA THALASSICA, new species.

Plate 3, fig. 4.

Shell small, snow white, with five or more whorls exclusive of the (lost) nucleus; suture distinct, appressed, the fasciole in front of it constricted, giving the whorls a conspicuous shoulder; spiral sculpture of a few obsolete threads on the base, not extending to the canal and with wider interspaces; axial sculpture of (on the penultimate whorl 16) strong obliquely protractive ribs, most prominent at the shoulder where they begin, disappearing on the base and obsolete on the last whorl; the incremental lines are inconspicuous; aperture rather wide, anal sulcus close to the suture, rounded, rather wide but not deep; outer lip thin, much produced; inner lip erased, pillar short, canal short, deep, distinct, recurved, with a distinct siphonal fasciole. Height of shell, 10; of last whorl, 5.5; diameter, 5 mm. Cat. No. 214206, U.S.N.M.

Range.—Station 3346, off Tillamook Bay, Oregon, in 786 fathoms, mud, bottom temperature 37.3° F. U. S. Bureau of Fisheries.

PLEUROTOMELLA OCEANIDA, new species.

Plate 3, fig. 5.

Shell small, thin, pure white, with five well-rounded whorls without the (lost) nucleus; suture distinct, anal fasciole wide, arcuately wrinkled; axial sculpture of (on the last whorl about 30) narrow thread-like ribs extending from the fasciole to the base with wider interspaces; also very fine close incremental lines; spiral sculpture of (on the penultimate whorl five or six) similar threads slightly nodulous where they intersect the ribs, with wider interspaces in each of which is a smaller intercalary thread; this sculpture extends to the base on the last whorl, the interspaces on the canal have no intercalary thread; aperture rather wide, anal sulcus rounded, deep, outer lip thin, produced, inner lip and pillar erased, the columella gyrate, attenuated in front, the axis pervious, the canal a little recurved. Height of shell, 12; of last whorl, 8.5; diameter 6.7 mm. Cat. No. 123117, U.S.N.M.

Range.—Station 3392, Gulf of Panama, U. S. Bureau of Fisheries steamer *Albatross* in 1,270 fathoms, bottom temperature 36.4° F.

GLYPHOSTOMA THALASSOMA Dall.

Plate 17, fig. 2.

Glyphostoma thalassoma DALL, Bull. Mus. Comp. Zoöl., vol. 43, No. 6, p. 290, Oct. 1908.

Range.—Station 3017, Gulf of California, off Cape Lobos, in 58 fathoms, mud, bottom temperature 61.8° F. Cat. No. 110612, U.S.N.M. The specimen selected for figuring is from 76 fathoms Cat. No. 223154, U.S.N.M.

GLYPHOSTOMA ADANA, new species.

Plate 17, fig. 1.

Shell small, slender, acute, whitish with the aperture more or less tinged with brown; nucleus white, glassy, with a minute globular apex and four subsequent whorls changing abruptly into the sculpture of the six subsequent whorls; the first of the latter has a peripheral keel changing on the next whorl to two and on the later whorls to three equidistant prominent cords with a smaller one behind and another in front of and close to the suture; on the last whorl the latter is obsolete and on the base there are 9 or 10 cords with interspaces widening toward the periphery, of which cords the more prominent are minutely nodulous or swollen when they cross the axial riblets; there is a wide concave anal fasciole in front of the suture with arcuate striation; the whorl at the suture somewhat appressed; axial sculpture is composed of about a dozen rather feeble ribs extending from the anal fasciole forward to the suture, but which are nearly obsolete on the second half of the last whorl; aperture rather narrow, the outer lip varicose, minutely denticulate within and with a sharp edge, the anal sulcus deep and rounded with a nodular callus on the body; inner lip with six or more denticulations; canal short, deep, and strongly recurved. Height of shell, 10; of last whorl, 5; diameter, 3.7 mm. Cat. No. 267597, U.S.N.M.

Range.—Head of Concepcion Bay, Lower California, Dr. Paul Bartsch.

This species resembles *G. adria*, but is lighter colored, smaller, and proportionately more slender.

GLYPHOSTOMA ADRIA, new species.

Plate 17, fig. 5.

Shell small, slender, acute, pale brownish, or with still paler nebulosity; with three darker brown nuclear whorls, the first minute, the others regularly increasing with a deep suture; subsequent whorls seven, the first peripherally keeled, the periphery rather anterior;

subsequent whorls with a broad spirally striated anal fasciole followed by two or three spiral cords strongest where they cross the ribs and feebler in the interspaces; on the last whorl the cords are less prominent, with about equal spirally striated interspaces, and the cords continue becoming more close-set toward and upon the canal to the number of 15 or more; axial sculpture of (on the last whorl 10, excluding the terminal varix) protractively oblique ribs extending from in front of the anal fasciole stronger on the periphery and obsolete on the base of the whorl; terminal varix strong, the margin incurved smooth; the anal fasciole large, rounded; the lips callous with minute denticulations; the canal short, deep, recurved, the aperture rather narrow. Height of shell, 10; of last whorl, 6; diameter, 4 mm. Cat. No. 269030, U.S.N.M.

Range.—Dredged at Santa Maria Bay, Lower California, Dr. Paul Bartsch.

GLYPHOSTOMA PARTEFILOSA, new species.

Plate 17, fig. 4.

Shell small, white, with pale brown spiral banding; nucleus small, smooth, glassy, followed by six sculptured whorls; suture distinct, the whorl with a shoulder immediately in front of it; spiral sculpture only of about 13 threads, covering the canal when it is not worn; axial sculpture of (on the last whorl 12) narrow, slightly oblique ribs, arcuate at the shoulder, not continuous over the spire and with wider interspaces; aperture narrow with a flaring anal sulcus and no subsutural callus; pillar short, denticulate, outer lip thickened, dentate within, canal short, recurved. Height of shell, 11; of last whorl, 6; diameter, 4.5 mm. Cat. No. 224413, U.S.N.M.

Range.—Off Cape Tepoca, Gulf of California, in 36 fathoms, sand.

GLYPHOSTOMA SIRENA, new species.

Plate 17, fig. 3.

Shell elongated slender, acute, waxen white clouded with light brown, nucleus pointed, the first whorl minute, the next two enlarging, all smooth; subsequent whorls seven, at first with a peripheral keel, later strongly ribbed and coarsely reticulated; spiral sculpture of a thread in front of the appressed and undulated suture, then, on successive turns of the spire, two, three and four coarse cords, with subequal interspaces between the fasciole and the suture, prominent only when they cross the ribs and feeble in the interspaces; on the last whorl there are nine of these and a few smaller threads on the canal; the anal fasciole is smooth narrow and close to the suture, undulated by the ends of the ribs; axial sculpture of (on the last

whorl nine) strong rounded ribs, feeble on the fasciole and reaching to the canal; aperture narrow, anal sulcus deep with a small subsutural callus; outer lip arcuate, prominently varicose, the edge infolded; inner lip and pillar smooth (possibly not quite adult); canal short, distinct, slightly recurved. Height of shell, 10; of last whorl, 5; diameter, 4 mm. Cat. No. 195004, U.S.N.M.

Range.—Station 2813, in the Galapagos Islands, in 40 fathoms, coral sand, surface temperature 81° F. U. S. Bureau of Fisheries.

This species is small for the genus and perhaps has not quite completed the callosities around the aperture.

GLYPHOSTOMA CYMODOCE, new species.

Plate 17, fig. 6.

Shell small, flesh colored, slender, acute, with a smooth small purple-brown nucleus of about two whorls and about six subsequent whorls; suture appressed with a slightly constricted fasciole immediately in front of it sculptured by half a dozen fine sharp close-set equal spiral threads; other spiral sculpture of (on the spire two to four) flattish spiral major cords with equal or wider interspaces in which runs an intercalary smaller thread: on the last whorl this sculpture is continuous over the shell from the shoulder to the base, but the intercalary threads gradually enlarge until they are practically equal to the originally larger cords; the small siphonal fasciole has a few finer and closer threads; axial sculpture of (on the penultimate whorl about eleven) rounded vertical ribs extending from the shoulder to the succeeding suture, but obsolete on the last whorl and not nodulose where they are intersected by the cords; the incremental lines are only conspicuous on the anal fasciole, where they are slightly puckered in front of the suture; aperture subovate, anal sulcus deep, rounded, close to the suture with a subsutural callus; outer lip thickened, slightly crenulate by the external sculpture, smooth within, arcuately produced, with a prominent varix behind it; inner lip erased, pillar short, canal short, distinct, slightly recurved. Height of shell, 11.5; of last whorl, 6; diameter, 4 mm. Cat. No. 150569, U.S.N.M.

Range.—Santa Barbara, California; Woodworth.

PHILBERTIA HESIONE, new species.

Shell small, whitish, biconic, acute, with a smooth bulbous nucleus of a whorl and a half and four and a half subsequent sculptured whorls; suture distinct, not appressed, the anal fasciole close to it, flattish, at first with fine spiral sculpture but on the last whorl it becomes nearly smooth; other spiral sculpture of a narrow prominent thread at the periphery which is doubled on the subsequent turns, on the last whorl there are eleven of the threads which are somewhat

nodulose where they override the ribs, with much wider interspaces, and a few close threads on the canal; axial sculpture of about 13 somewhat oblique narrow ribs, extending from the suture to the shoulder on the spire, and on the last whorl obsolete on the base; they are separated by wider interspaces and the incremental lines are feeble; aperture narrow, the anal sulcus narrow, deep, rounded, close to the suture, with a conspicuous subsutural callus; outer lip thin with a moderate varix behind it, and no internal lirae; inner lip erased, pillar short; canal short, deep distinct, slightly constricted and recurved; there is a small nodule at the inner anterior end of the outer lip where the canal begins. Height of shell, 9.5; of last whorl, 6; diameter, 4 mm. Cat. No. 211333, U.S.N.M.

Range.—Station 2902, off Santa Rosa Island, California, in 53 fathoms, sandy mud, bottom temperature 49° F. U. S. Bureau of Fisheries.

PHILBERTIA HELENA, new species.

Plate 18, fig. 2.

Shell minute, solid, pale yellowish brown, strongly sculptured; nucleus low, rapidly increasing, of about two whorls, the last one keeled, otherwise smooth; subsequent whorls four with a deeply constricted, not appressed suture; axial sculpture of (on the last whorl seven) strong ribs angulated at the periphery, with subequal deep interspaces, and which are not continuous up the spire; spiral sculpture of on the upper whorl one, on the third two, on the last whorl about seven obscure rounded rather coarse threads with narrower interspaces; aperture narrow; anal sulcus shallow close to the suture; outer lip varicose, smooth within, inner lip smooth, pillar short, straight, canal not differentiated from the aperture. Height of shell, 3.5; of last whorl, 1.5; diameter, 1.25 mm. Cat. No. 268910, U.S.N.M.

Range.—Agua Verde Bay, Gulf of California. Dr. Paul Bartsch.

PHILBERTIA DORIS, new species.

Plate 18, fig. 4.

Shell minute, yellowish white, acute, slender, with a small, elevated nucleus of three whorls, its apex minute, smooth, the last whorl microscopically axially ribbed; subsequent whorls reticulate, well rounded, with a distinct not appressed suture; spiral sculpture on the spire of strong cords, not nodulate at the intersections, three at the first, four or five on the next two, and about a dozen on the last whorl, equal with equal interspaces and separated from the preceding suture by a finely striated anal fasciole; axial sculpture of (on the last whorl 13) slender, equal, rounded ribs extending from the suture to the canal, with wider interspaces, not continuous up the spire and nearly parallel with the axis; aperture ovate, anal sulcus conspicuous, rounded, close to the suture; outer lip varicose, sharp edged, smooth

within; inner lip erased: canal short but distinct. Height of shell, 5.2; of last whorl, 3.25; diameter, 2.5 mm. Cat. No. 268703*a*, U.S.N.M.

Range.—Dredged in Agua Verde Bay, Gulf of California. Dr. Paul Bartsch.

? PHILBERTIA DIONE, new species.

Shell minute, whitish or yellowish with whiter mottling, subcylindric, coarsely sculptured, with about six whorls exclusive of the (lost) nucleus; suture obscure, constricted, somewhat appressed; spiral sculpture of (on the earlier whorls two, on the later ones three) strong equal cords, slightly swollen at the intersections and with somewhat narrower interspaces, the suture is laid on a fourth cord which is usually invisible; on the last whorl there are eight of these cords, the last one nodulous; there are three or four smaller threads on the canal; axial sculpture of coarse incremental lines and (on the last whorl 9 or 10) rounded ribs extending from the suture to the base, continuous up the spire which they half encircle; aperture narrow, anal sulcus shallow and wide, outer lip slightly thickened with a few lirae inside; inner lip smooth, canal narrow, very short. Height of (decollate) shell, 5; of last whorl, 2.8; diameter, 2 mm. Cat. No. 268703, U.S.N.M.

Range.—With the preceding species.

PHILBERTIA EPHAEDRA, new species.

Shell small, slender, acute, very pale brown or whitish, the nucleus with its apical whorl minute, transparent, smooth, bubble-like, followed by one and a half faintly reticulate whorls; subsequent whorls five and a half with a deep appressed suture; spiral sculpture of alternate threads with narrower interspaces, the major threads (on the spire two or three) rather prominent, especially the posterior one, which forms a sort of shoulder to the whorl, more conspicuous in the earlier whorls; the minor threads usually number one on the spire, but on the last whorl sometimes two or even three in the interspaces between the major threads; the threads are little or not at all swollen where they cross the ribs but are rendered harsh by the intersection of fine sharp close-set incremental lines; other axial sculpture of (on the last whorl seven) prominent rounded ribs, crossing the whole whorl, with subequal interspaces, and practically continuous vertically up the spire; there is no obvious anal fasciole; aperture narrow, the anal sulcus shallow, rounded, with no subsutural callus; outer lip subvaricose, moderately infolded, with a sharp edge, smooth inside; inner lip erased; canal short, wide, hardly recurved. Height of shell, 8.3; of last whorl, 5; diameter, 3.2 mm. Cat. No. 274107, U.S.N.M.

Range.—In beach drift at Panama; James Zetek.

PHILBERTIA AETHRA, new species.

Plate 18, fig. 6.

Shell small, acute, pale brownish, with a smooth acute nucleus of two whorls and six subsequent whorls, the first of which has two peripheral spiral threads with an angle at the shoulder; other spiral sculpture of somewhat alternated small uniform close-set threads, made minutely scabrous by the intersection of sharp incremental lines and covering the whole surface; axial sculpture otherwise of six prominent sharp vertical ribs with much wider interspaces, practically continuous up the spire and extending from the suture to the canal; aperture narrow, anal sulcus shallow, rounded, not preceded by any obvious fasciole, close to the suture; outer lip with a thickened varix behind it, sharp edged without internal lirae; inner lip slightly erased; canal narrow short, distinct. Height of shell, 8; of last whorl, 4.5; diameter, 3.3 mm. Cat. No. 211382, U.S.N.M.

Range.—Station 2823, off La Paz, Lower California, in 26½ fathoms broken shelly bottom. U. S. Bureau of Fisheries.

PHILBERTIA DICTYNNA, new species.

Plate 18, fig. 3.

Shell small, translucent white, with one and a half small smooth nuclear and four subsequent well-rounded whorls; suture distinct, not appressed; spiral sculpture of (on the last whorl about 10) subequal and equally spaced strong rounded threads, nodulous on the periphery where they intersect the ribs and feebler on the canal; axial sculpture of (on the last whorl about 10) short rounded ribs prominent only near the periphery and with wider interspaces; aperture elongate-ovate, anal sulcus wide and very shallow, outer lip thin, smooth inside, moderately produced; inner lip erased, pillar short, canal very short, slightly recurved. Height of shell, 3.8; of last whorl, 2.7; diameter, 2 mm. Cat. No. 4085, U.S.N.M.

Range.—Cape San Lucas, Lower California; J. Xantus.

PHILBERTIA SCAMMONI, new species.

Plate 18, fig. 1.

Shell small, whitish, with brown interspaces or bands, more or less variable; nucleus small, blunt, turbinate, the first whorl smooth, the third obliquely minutely axially ribbed; subsequent whorls five, with a rather deep suture the whorls rounded, uniformly sculptured; spiral sculpture of two kinds, on the spire two major threads near the periphery and four on the last whorl, whiter than the rest of the surface; in the interspaces much finer threads, the major threads hardly swollen where they override the ribs; on the base the sculpture takes the form of flattish bands appressed on the anterior edge, about four in number, on the canal are only four or five close-set

rounded threads; axial sculpture of (on the last whorl including the terminal varix 10) rounded, rather strong ribs, extending from suture to canal and usually vertically continuous up the spire, the shoulder hardly indicated, the spiral sculpture passing over the ribs without nodulation; the interspaces of the reticulation usually darker colored than the threads; aperture narrow, elongated, with a large rounded and conspicuous anal sulcus; outer lip varicose, thick, sharp edged, internally smooth; inner lip smooth not callous; canal short, wide, hardly differentiated from the aperture. Height of shell, 7; of last whorl, 4; diameter, 2.5 mm. Cat. No. 106488, U.S.N.M.

Range.—Scammon Lagoon, Lower California, on a sand beach between tides; Henry Hemphill.

PHILBERTIA TELAMON, new species.

Plate 18, fig. 5.

Shell minute, snow white, polished, with a dark brown narrow band in front of which the suture is laid; nucleus of one and a half white smooth whorls and four and a half strongly sculptured subsequent whorls; suture distinct, not appressed; spiral sculpture of on the first two whorls one, on the next two, two strong white rounded cords on the periphery and a brown one at the suture, somewhat swollen at their intersections with the ribs and separated by a narrower interspace; on the last whorl there are in front of these three or four similar but slightly smaller white cords and a few small threads on the canal; axial sculpture of (on the last whorl about ten) rounded ribs extending over the whorl but not continuous up the spire and with narrower interspaces; outer lip strongly varicose; anal sulcus distinct, small, shallow, the whorl somewhat constricted at the beginning of the canal; pillar short smooth, canal very short but distinct. Height of shell, 4; of last whorl, 2; diameter, 2 mm. Cat. No. 73927, U.S.N.M.

Range.—Gulf of California, Stearns collection.

This is a very distinct little species, recalling in color some species of *Triforis*.

PHILBERTIA AEGIALEA, new species.

Plate 18, fig. 8.

Shell small, yellowish white, slender, acute, with a small smooth nucleus of a whorl and a half and four and a half subsequent sculptured whorls; suture distinct, not appressed, undulated by the ends of the ribs; whorls with a prominent shoulder; spiral sculpture of small sharp close-set threads covering the whole surface most prominent in the interspaces between the ribs and given a frosty appearance by the intersection of close fine sharp slightly elevated incremental lines; other axial sculpture of (on the last whorl eight) strong rounded ribs with wider interspaces extending to the canal from the preceding

suture and not continuous up the spire; aperture narrow, anal sulcus wide and round but with no marked fasciole or subsutural callus; outer lip thick, infolded, the fine sculpture continued over the front of the fold; inner lip erased, pillar straight, canal very short and wide but distinct. Height of shell, 7; of last whorl, 4; diameter, 3 mm. Cat. No. 274101, U.S.N.M.

Range.—Margarita Bay, Lower California; C. R. Orcutt.

This shell has a curious resemblance in miniature to *Alectrion cooperi.*

Section NANNODIELLA Dall.

Minute Turritidae with a glassy nucleus of several whorls finally developing spiral threads, but otherwise smooth; the adult sculpture predominantly spiral, the anal sulcus large with a projecting margin, the outer lip in front of it thin and much incurved over the aperture; the aperture unarmed, the canal short, the animal inoperculate.

Type.—Nannodiella nana, new species.

This group is instituted for a number of minute species which are remarkable for their relatively enormous anal sulcus, often half as large as the aperture. Those so far recognized are inhabitants of the Gulf of California and its vicinity.

PHILBERTIA (NANNODIELLA) NANA, new species.

Plate 20, fig. 7.

Shell minute, thin, whitish with touches of brown near the aperture; nucleus translucent, the apex minute, globular, the whorls rapidly increasing, convex, smooth, except the fourth which develops one or two spiral threads; subsequent whorls four, with a prominent sharp peripheral keel somewhat undulated but not swollen by axial sculpture; the entire space between this keel and the preceding suture is taken up by the arcuately striate nearly smooth, flattish anal fasciole which is appressed at the suture; in front of the peripheral keel is a less prominent keel on which the suture is laid, the space between the two keels is divided into squarish shallow pits by axial ridges; the base is spirally threaded with subequal interspaces, the threads sometimes minutely scabrous from the intersection by axial striation; aperture subtriangular, short, the anal sulcus not quite at the suture, very large and deep the margin projecting; in front of it the thin outer lip is produced and more or less incurved, the inner lip with a wash of callus, the canal distinct, short, recurved. Height of shell, 3.5; of last whorl, 2; diameter, 1.5 mm. Cat. No. 194857, U.S.N.M.

Range.—Off Cacachitas, Gulf of California in 26 fathoms. Also off La Paz in 9 to 10 fathoms mud, and near Cape San Lucas. U. S. Bureau of Fisheries.

This little shell is very abundant in the siftings from the mud at the above localities.

PHILBERTIA (NANNODIELLA) FRATERNALIS, new species.

Plate 20, fig. 5.

Shell similar in size and general aspect to the preceding and best described by a comparative diagnosis. The nucleus is shorter and less acute; the peripheral keel is less prominent and more or less nodulous at intersections with axial sculpture; there is a space between the second keel and the succeeding suture, both the interspaces are strongly latticed; the anal fasciole is conspicuously spirally threaded; the axial sculpture of narrow riblets with wider interspaces extends forward from the peripheral carina which it nodulates and on the last whorl reaches more or less distinctly over the base; there are three instead of two keels near the periphery on the last whorl. Height, 4.75; height of last whorl, 2.5; diameter, 1.75 mm. Cat. No. 271401, U.S.N.M.

Range.—Near Cape San Lucas, Lower California, at Station 2822, in 21 fathoms, sandy bottom. U. S. Bureau of Fisheries steamer *Albatross.*

This would have been regarded as a variety of *nana* had it not been for the constant difference in the nuclear whorls. The sharp angular outlines of *nana* give it a character very different from the present form at first sight. It is comparatively rare.

PHILBERTIA (NANNODIELLA) PHYLIRA, new species.

Plate 20, fig. 6.

Shell small, slender, thin, waxen white, with a narrow purple-brown band in front of the suture in the later whorls, the pillar and canal more or less similarly tinted; nucleus very small, rather blunt, with the latter part spirally threaded, of about one and a half whorls, followed by about six subsequent whorls; spiral sculpture of (on the early whorls one, later two, and on the last whorl three) strong, rather widely separated threads which are prominently nodulous where they cross the ribs and on the spire are feeble in the interspaces; suture appressed, obscure, the anal fasciole inconspicuous behind the first row of nodules; on the base are 3 or 4 distant threads and on the canal a few feeble spirals; axial sculpture (on the last whorl of about 15) narrow sharp nearly vertical ribs with wider interspaces, the general surface between them with more or less prominent incremental sculpture; aperture narrow, anal sulcus feeble, outer lip thin, smooth inside, inner lip smooth, canal distinct, short, straight. Height of shell, 7; of last whorl, 4.25; diameter, 2 mm. Cat. No. 274108, U.S.N.M.

Range.—Panama, in beach drift, James Zetek.

This shell superficially resembles "*Aesopus*" *oldroydi* Arnold, differing from the latter in details of sculpture, being more slender and smaller, etc. It has more the sculpture of a *Nannodiella* than an *Aesopus* and when adult probably has the *Nannodiella* aperture.

PHILBERTIA (? NANNODIELLA) AMYELA, new species.

Plate 20, fig. 8.

Shell minute, thin, white, with a pervious axis and five whorls, exclusive of the nucleus, of which one smooth whorl remains, the apical part being defective; the sculpture begins abruptly and consists of (on the spire two, on the last whorl three) fine very widely spaced spiral threads, with four or five closer threads on the canal; these cross (on the last whorl about 10) slender axial riblets (obsolete on the base) also widely spaced, and at the intersections form minute spinose tubercles; the other axial sculpture consists of microscopic crowded fine threads over the whole surface, more regular and defined than incremental lines; the aperture is ovate, the anal sulcus obscure, the outer lip (immature ?) thin, the pillar lip gyrate, the canal hardly differentiated. Height of shell, 4.5; of last whorl, 2.5; diameter, 1.5 mm. Cat. No. 216944, U.S.N.M.

Range.—Panama, James Zetek.

This shell recalls by its sculpture the *Nannodiella* of the Gulf of California, and if so related would have a different aperture at maturity.

PHILBERTIA HILAIRA, new species.

Plate 23, fig. 6.

Shell small, translucent white, elevated, with two or more smooth nuclear whorls (defective in the specimen) and five subsequent reticulated, moderately rounded, slightly shouldered whorls; suture distinct, not appressed; spiral sculpture of (on the penultimate whorl four) stronger threads the posterior forming the shoulder, and between them in the wider interspaces much finer intercalary threads; on the base the minor threads become close-set and coarser; axial sculpture of (on the last whorl fourteen or more) low threadlike ribs extending to the canal and shortly sigmoid behind the shoulder; aperture narrow, outer lip varicose, within smooth, though the spiral sculpture shining through the translucent shell gives the effect of liration; anal sulcus wide and shallow, canal hardly differentiated. Height of shell, 6.5; of last whorl, 4; diameter, 2.5 mm. Cat. No. 73925, U.S.N.M.

Range.—Gulf of California, Stearns collection.

This species has a higher spire than most of the genus, but can hardly be separated from the others on that ground alone. It is possible that fresh specimens might show traces of color.

PHILBERTIA CRYSTALLINA Gabb.

Plate 13, fig. 1.

Clathurella crystallina GABB, Proc. Cal. Acad., vol. 3, p. 184, 1865.
Clathurella lowei DALL, Proc. Biol. Soc. Wash., vol. 16, p. 172, 1903.

Range.—Santa Barbara Channel, California, in 40 fathoms.

PHILBERTIA TRICHODES, new name.

Plate 19, fig. 3.

Pleurotoma hirsutum DE FOLIN, Méléagrinicoles, p. 59, pl. 5, fig. 16, 1867; not of Bellardi, 1847.

Range.—Panama Bay.

The figure does not show the acute projection of the nodes.

MANGILIA (CLATHROMANGILIA) LEVIDENSIS Carpenter.

Plate 21, fig. 1.

Mangelia levidensis CARPENTER, Proc. Acad. Nat. Sci. Phila. for 1865, p. 63, April, 1865.

Range.—North end of Nunivak Island, Bering Sea, and south to the Aleutians and Puget Sound. The specimen figured is Cat. No. 133239, U.S.N.M.

Carpenter's types from Neeah Bay and Puget Sound were badly worn, imperfect specimens, hardly identifiable. The color of the fresh shell is dark brown, and the sculpture on the last whorl in senile specimens is often more or less obsolete.

MANGILIA (CLATHROMANGILIA) RHYSSA, new species.

Plate 21, fig. 3.

Shell small, brownish, coarsely sculptured, with six whorls exclusive of the (lost) nucleus; suture appressed, somewhat constricted, obscure; upper whorls with two prominent cords crossing the ribs without nodulation, the last whorl with six, the spiral sculpture more prominent than the axial, which consists of (on the last whorl 10) straight axial ribs continuous to the base; there are traces of some fine spiral striation; the interstices of the reticulation are deep and squarish; sutural fasciole obscure, the sulcus very shallow, the aperture short with hardly any canal and no denticulations or lirations. Height of shell, 7; of last whorl, 4; diameter, 2 mm. Cat. No. 55479, U.S.N.M.

Range.—Gulf of California, Stearns collection.

MANGILIA (KURTZIELLA) CYRENE, new species.

Plate 21, fig. 5.

Shell minute, waxen white, nucleus very small, of one and a half smooth whorls, rapidly enlarging, followed by a minutely reticulated turn, of which the sculpture gradually merges into that of the

adult type of four succeeding moderately rounded whorls separated by a distinct, not appressed suture; spiral sculpture of a prominent sharp thread on the periphery slightly angulating it; above this on the last whorl are two and below it on the base six or seven somewhat smaller threads with wider interspaces followed to the end of the canal by a more adjacent series of similar threads; axial sculpture of (about 10 on the last whorl) rounded ribs extending from the suture over the base with much wider interspaces; incremental lines close-set, sharp, minutely raised, giving a frosted effect to the surface; aperture narrowly ovate, the outer lip thin, sharp, the anal fasciole feebly indicated, the inner lip and pillar smooth, the canal distinct, straight, short, and narrow. Height of shell, 4.25; of last whorl, 2.75; diameter, 1.25 mm. Cat. No. 211384, U.S.N.M.

Range.—Station 2823, off La Paz, Lower California, in about 26 fathoms, broken shell. U. S. Bureau of Fisheries.

It is possible that these shells may not be completely adult and that the aperture may be modified later, but none of the many specimens obtained show any indications of it.

MANGILIA (KURTZIELLA) DANAË, new species.

Plate 21, fig. 6.

Shell minute, whitish, with a narrow brown band below the periphery in front of which the suture is laid; nucleus small with one and a half polished whorls followed by four and a half sculptured whorls; suture distinct, undulated not appressed; spiral sculpture of a strong cord at the periphery angulating the whorls, with smaller threads (sometimes alternated) covering the rest of the surface with about equal interspaces; spiral sculpture of (on the last whorl 10) slightly sigmoid ribs, widest at the periphery, reaching the suture and fading out on the base, with narrower interspaces; on the obscure anal fasciole the interspaces are markedly concave; aperture narrow, the anal sulcus wide, shallow, the outer lip varicose; the inner lip smooth, the pillar straight, the canal hardly differentiated. Height of shell, 4.5; of last whorl, 3; diameter, 1.7 mm. Cat. No. 265920, U.S.N.M.

Range.—Mulege, Gulf of California, Dr. Paul Bartsch.

MANGILIA (KURTZIELLA) HEBE, new species.

Plate 20, fig. 10.

Shell small, yellowish white, slender, acute, with two smooth nuclear and five or six subsequent whorls; spiral sculpture of fine equal uniform threads covering the whole whorl separated by narrow grooves and given a frosty appearance by fine sharp incremental lines; axial sculpture of (on the last whorl eight or nine) narrow rounded ribs extended over the whole whorl with wider interspaces

and somewhat constricted in front of the appressed suture; there is no evident anal fasciole apart from the constriction; aperture narrow, anal sulcus hardly evident, outer lip sharp, moderately varicose, smooth inside, with the spiral sculpture showing through the thin shell; inner lip erased, pillar straight, canal produced but hardly differentiated. Height of shell, 10; of last whorl, 6; diameter, 3.5 mm. Cat. No. 159338, U.S.N.M.

Range.—San Diego Bay, California, C. R. Orcutt.

This belongs to the same group as *P. limonitella* Dall, of the Atlantic coast.

MANGILIA (KURTZIELLA) ARTEAGA ROPERI, new variety.

Plate 22, fig. 5.

Shell small, thin, grayish with a very minute apical followed by two more or less reticulate convex nuclear whorls and four and a half subsequent whorls; suture distinct, not appressed: spiral sculpture of on the upper whorls one strong peripheral cord in front of which on the penultimate whorl is a smaller one and on the last whorl about five smaller ones with wider interspaces, on the canal five or six closer small threads; in the interspaces of the major cords are numerous minute and minutely imbricated close-set threads, giving a rasplike surface; axial sculpture of (on the last whorl nine) narrow rounded threads with wider interspaces, extending from the fasciole to the canal and nodulous at the intersection of the peripheral cord; aperture narrow, simple, anal sulcus feeble, producing hardly any appearance of a fasciole; axis nearly pervious, canal short, straight. Height of shell, 6.5; of last whorl, 4; diameter, 2.5 mm. Cat. No. 150993, U.S.N.M.

Range.—Monterey, California, to Lower California, in 12 to 15 fathoms.

This species belongs to the group represented on the Atlantic coast by such species as *M. limonitella* Dall, *M. cerina* Kurtz and Stimpson, etc., notable for their rasplike minor sculpture. It is more slender than the typical *M. arteaga* and more southern in distribution. The nucleus is usually eroded and then appears smooth. If deemed worthy of a sectional distinction I have suggested the name of *Kurtziella*, with *M. cerina* as the type.

MANGILIA (KURTZIELLA ?) BETA, new species.

Plate 22, fig. 4.

Shell small, yellowish, with a pale canal, a blunt smooth nucleus of two whorls and three and a half subsequent whorls; periphery slightly behind the middle of the whorl; from the distinct suture the surface slopes flatly to the subangular periphery, the rest of the whorl rounded; spiral sculpture of uniform fine threads with narrower interspaces over the whole surface; axial sculpture of (on the

last whorl 15) narrow rather sharp ribs with much wider interspaces, obsolete behind the shoulder and on the base; there are also fine incremental lines which roughen the spiral threads; anal fasciole inconspicuous, anal sulcus feeble; aperture simple, outer lip sharp; axis pervious, pillar attenuated in front, canal short. Height of shell, 5; of last whorl, 3.5; diameter, 2 mm. Cat. No. 206554, U.S.N.M.

Range.—Off Point Año Nuevo, California, in 56 fathoms, mud, bottom temperature 49.2° F. U. S. Bureau of Fisheries steamer *Albatross.*

This shell is quite characteristic, though doubtless immature.

MANGILIA PERATTENUATA Dall.

Plate 20, fig. 11.

Mangilia perattenuata DALL, Nautilus, vol. 18, No. 11, p. 123, Mar. 8, 1905.

Range.—Monterey Bay, 10 to 45 fathoms.

This is larger and more slender than the allied *constricta* Gabb.

MANGILIA PAINEI Arnold.

Plate 23, fig. 3.

Mangilia painei ARNOLD, Pal. San Pedro, p. 214, pl. 8, fig. 1, 1903.

Shell small, slender, whitish, with one subglobular nuclear and six subsequent whorls, suture distinct, undulated by the sculpture; spiral sculpture on the apical whorls of two cords near the periphery, overrunning the ribs and becoming fainter with each succeeding whorl and quite obsolete on the last two whorls; axial sculpture of (on the last whorl 10 or 11) rounded protractive ribs with subequal interspaces, extending from the fasciole to the succeeding suture and on the earlier whorls from suture to suture; the incremental lines are also distinct but not coarse; anal fasciole feeble, the sulcus obscure; aperture simple, the pillar attenuated in front, canal short. Height of shell, 15; of last whorl, 9; diameter, 4.5 mm. Cat. No. 161420, U.S.N.M.

Range.—San Pedro, California, Mrs. Eshnaur. Also Pleistocene.

First described as a fossil. The strength of the sculpture varies in different specimens.

MANGILIA NUNIVAKENSIS, new species.

Plate 1, fig. 2.

Shell thin, rather large, whitish, acute, elevated, of about seven whorls, the nucleus eroded, suture distinct, the anal fasciole hardly constricted, concavely wrinkled; axial sculpture of (on the penultimate whorl about 18) protractive rather feeble, rounded ribs, with subequal interspaces, becoming obsolete on the base; spiral sculpture practically none; aperture simple, anal sulcus wide and shallow, outer lip arcuate, canal straight. Height of shell, 18; of last whorl, 12; diameter, 6 mm. Cat. No. 220348, U.S.N.M.

Range.—Bering Sea near Nunivak Island, in 9 to 85 fathoms, mud, bottom temperature 39° F. W. H. Dall.

This species belongs to the group including *M. aleutica* and *M. alaskensis* Dall.

MANGILIA OENOA, new species.

Plate 8, fig. 6.

Shell small, feebly sculptured, whitish with a yellowish underlayer, and (on the spire one, on the last whorl two) darker spiral lines: whorls six without the (lost) nucleus; suture distinct, anal fasciole obscure; surface with uniform fine spiral striation; axial sculpture of (on the last whorl about 15) faint narrow riblets extending entirely over the whorl with wider interspaces; aperture narrow, canal short, wide; anal sulcus faint; outer lip thin sharp, body and pillar smooth. Height of shell, 6.5; of last whorl, 4; diameter, 2.5 mm. Cat. No. 153051, U.S.N.M.

Range.—San Pedro, California, to the Gulf of California.

This belongs to the group of *M. variegata* Carpenter, but has much less developed sculpture and color markings.

MANGILIA PHILODICE, new species.

Plate 22, fig. 7.

Shell small, white, with four or more whorls exclusive of the (lost) nucleus; suture distinct, not appressed; whorls sloping behind, rounded in front; axial sculpture of (on the penultimate whorl about 17) short rounded ribs with subequal interspaces, hardly extended over the periphery and gradually becoming obsolete on the last whorl; incremental lines somewhat conspicuous on the base where they slightly reticulate the spiral sculpture; the latter comprises three prominent cords on the periphery equal and equidistant, swollen where they over ride the ribs, and feebler on the last whorl; the anal fasciole carries finer equal spiral threads, the base 10 or more somewhat larger and more nearly adjacent as they approach the canal; aperture rather narrow, outer lip solid, sharp-edged, anal sulcus large, rounded, close to the suture, inner lip erased, canal short, deep, slightly recurved. Height of last and three preceding whorls, 7.5: of last whorl, 5; diameter, 3 mm. Cat. No. 208916, U.S.N.M.

Range.—Station 4454, off Point Pinos Light, Monterey Bay, California, in 65 to 203 fathoms, mud and gravel. U. S. Bureau of Fisheries.

MANGILIA PATAGONIENSIS, new species.

Shell minute, white, with a blunt nucleus of one and a half whorls the apex bulbous, and about four subsequent whorls; suture appressed, and fasciole somewhat concave; axial sculpture of (on the penultimate whorl about 18) short rounded obliquely protractive ribs with

narrower interspaces extending from the succeeding suture to the anterior edge of the anal fasciole and across it as an arcuate thread to the preceding suture; these ribs become more or less obsolete on the last whorl and are feebly if at all produced beyond the periphery; spiral sculpture between the fasciole and the succeeding suture of five or six equal and equidistant strong threads with subequal interspaces on the penultimate whorl and about a dozen on the base of the last whorl, with smaller and closer ones on the canal; the angle at the anterior edge of the fasciole is prominent, the threads are hardly swollen when they pass over the ribs; aperture narrow, the anal sulcus shallow and wide beginning at the suture; outer lip thin, sharp; inner lip erased; pillar and canal straight, the latter distinct but short and deep. Height of shell, 5.5; of last whorl, 3.7; diameter, 3 mm. Cat. No. 122751, U.S.N.M.

Range.—Station 2787, on the west coast of Patagonia in 61 fathoms, mud, bottom temperature 54° F. U. S. Bureau of Fisheries.

This shell looks like a small *Bela*, but has no operculum.

MANGILIA ERIOPIS, new species.

Plate 23, fig. 1.

Shell small, white, polished, having a nucleus with an oblique smooth small apex and about one whorl, the latter part spirally striated, and about six and a half subsequent whorls; spire acute, slender, the whorls moderately rounded, the suture distinct, not appressed; spiral sculpture of a few obscure threads on the back of the canal and on the apical whorls; axial sculpture of (on the last whorl about 15) sigmoid ribs, most prominent at the shoulder, feeble over the anal fasciole and on the base; aperture narrowly ovate, anal sulcus shallow and wide, beginning at the suture; outer lip produced, thin and sharp; inner lip and pillar with a thin wash of enamel; pillar straight, attenuated in front, canal short and narrow. Height of shell, 13.5; of last whorl, 7.5; diameter, 5 mm. Cat. No. 216411, U.S.N.M.

Range.—Forrester Island, southeastern Alaska, collected by G. Willett.

MANGILIA GRANITICA, new species.

Shell small, waxen white, darker on the pillar, with two nuclear and about five subsequent whorls; nucleus flat-topped, the first whorl with one strong keel, the second with three, the suture is laid on the anterior keel, which is smaller, and in the subsequent whorls the suture is not appressed but distinct; spiral sculpture of on the first two whorls a strong peripheral cord and one thread at the suture, on the third whorl three threads in front of the cord, on the remainder four, on the last whorl the peripheral cord is not prominent but from the anal fasciole to the canal are about 16 strong threads with wider

interspaces and an occasional intercalary smaller thread; they do not nodulate when they cross the ribs; on the canal are numerous small close-set threads; the anal fasciole is without spiral sculpture; axial sculpture of (on the last whorl 13) strong rounded ribs not continuous up the spire and obsolete on the base but prominent and arcuate over the fasciole, reaching the preceding suture which they undulate; aperture rather narrow, the anal fasciole at the suture, shallow and wide, the outer lip thin, moderately produced, the inner lip smooth, erased; pillar short, straight, attenuated in front, canal short but distinct. Height of shell, 13; of last whorl, 8; diameter, 5 mm. Cat. No. 208560, U.S.N.M.

Range.—Granite Cove, Port Althorp, Alaska, in about 10 fathoms, gravel; W. H. Dall.

MANGILIA ALTHORPI, new species.

Plate 19, fig. 9.

Shell small, waxen white, superficially resembling *M. granitica* Dall but differing in the following particulars: It has one rib less; the two prominent spiral cords on the early whorls are strongly nodulous when they cross the ribs, especially the posterior cord, even on the last whorl; the spiral sculpture on the last whorl in front of the fasciole comprises 10 strong flattish cords, separated by very sharp, narrow grooves, with no spiral sculpture on the back of the canal, which is distinctly shorter; aperture relatively shorter and wider; the nucleus apparently similar but eroded, the number of whorls is the same but the shell is shorter. Height of shell, 11.5; of last whorl, 6.5; diameter, 4.5 mm. Cat. No. 208560*a*, U.S.N.M.

Range.—Station 1413, Granite Cove, Port Althorp, Alaska, in about 10 fathoms, gravel, W. H. Dall.

MANGILIA CARLOTTAE, new species.

Plate 21, figs. 9, 12.

Shell small, thin, snow white, with a swollen smooth nucleus of two whorls and six subsequent whorls; suture distinct, not appressed; the anal fasciole sloping forward flatly to the shoulder of the whorl with only arcuate incremental lines for sculpture; axial sculpture of (on the last whorl about 20) obliquely protractive short ribs, strongest at the shoulder and on the last whorl stopping abruptly near the periphery; spiral sculpture hardly perceptible, on the base are a few distant obsolete threads and faint microscopic striae; these vary in strength in different specimens; anal sulcus rounded, wide and shallow; outer lip thin, sharp, arcuately produced; aperture narrowly ovate, inner lip erased; pillar and canal short, the latter wide and hardly differentiated. Height of shell, 9; of last whorl, 5.5; diameter, 4 mm. Cat. No. 210724, U.S.N.M.

Range.—Station 2860, off Queen Charlotte Islands, British Columbia, in 876 fathoms, mud, bottom temperature 36.5° F. U. S. Bureau of Fisheries.

MANGILIA EVADNE, new species.

Plate 23, fig. 2.

Shell small, white, slender, with a smooth swollen nucleus of one and a half whorls and five subsequent whorls; suture constricted, distinct, not appressed, the whorls sloping flatly toward it on both sides; axial sculpture only of faint incremental lines; spiral sculpture of one very prominent keel at the shoulder with one smaller and several still finer threads behind it, the anal fasciole smooth; on the last whorl there are two major threads with much wider interspaces, in front of them about six smaller closer threads to the canal which has about six close-set threads and a marked siphonal fasciole; aperture rather narrow, the anal sulcus deep, rounded, separated by a single thread from the suture; outer lip thin, produced, sharp; inner lip erased, pillar straight; canal distinct, rather wide and recurved. Height of shell, 12; of last whorl, 3.5; diameter, 3 mm. Cat. No. 211334, U.S.N.M.

Range.—Station 2902, off Santa Rosa Island, California, in 53 fathoms sandy mud, bottom temperature 45° F. U. S. Bureau of Fisheries.

This is an odd and extremely distinct species, which recalls some forms of *Cryptogemma*, but is obviously too small for that genus.

MANGILIA ERIPHYLE, new species.

Shell small, solid, whitish, acute, fusiform, with one and a half nuclear and six subsequent whorls; nucleus with a minute apex and a swollen smooth globular succeeding whorl; these are followed by a peripherally keeled whorl, the subsequent turns developing two and then three spiral flattish spiral cords, including the peripheral one and in front of it, while behind the keel the surface slopes flatly up to the appressed suture only interrupted by obscure ridges due to the axial sculpture; on the last whorl in front of the anal fasciole there are about a dozen similar cords extending to the end of the canal with about equal channelled interspaces, the posterior two or three cords more or less nodulous at the intersections; axial sculpture of about 10 more or less prominent riblets beginning in front of the fasciole and extending slightly over the periphery on the last whorl becoming obsolete; the incremental lines not conspicuous; aperture narrowly ovate, the outer lip somewhat varicose with a large shallow rounded anal sulcus close to the suture; within both inner and outer lips are smooth and moderately callous; canal

short, wide, slightly recurved. Height of shell, 10.5; of last whorl, 6; diameter, 4 mm. Cat No. 211326, U.S.N.M.

Range.—Station 2902, off Santa Rosa Island, California, in 53 fathoms sandy mud, temperature 45° F. U. S. Bureau of Fisheries.

The specimens were all dead shells and the color when fresh is therefore doubtful.

MANGILIA HERMIONE, new species.

Plate 19, fig. 6.

Shell small, white, decollate, but originally of five or more whorls exclusive of the nucleus; first two remaining intact whorls (the first is eroded) axially sculptured with about 20 close-set obliquely protractive rounded ribs cut by sharp grooves which make of the interspaces rounded nodules, the second row from the preceding suture being more prominent and forming a shoulder to the whorl; there are five of these rows on the spire, and the ribs they represent extend from suture to suture; on the later whorls they are less prominent, and on the last are obsolete except at the shoulder which is feeble; other spiral sculpture on the last whorl is of fine equal threads with narrower interspaces, extending from the shoulder to the canal; suture distinct, not appressed, whorls well rounded; aperture rather narrow, anal sulcus wide and deep, its deepest part at the shoulder, with no subsutural callus; outer lip thin, sharp, prominently arcuately produced; inner lip erased, pillar short, gyrate, axis not pervious; canal distinct, rather long and wide. Height of three intact whorls, 8; of last whorl, 6.5; diameter at apex, 1.6; of last whorl, 4 mm. Cat. No. 96488, U.S.N.M.

Range.—Station 2807, near Galapagos Islands, in 812 fathoms, ooze, bottom temperature 38.4° F. U. S. Bureau of Fisheries.

MANGILIA LAODICE, new species.

Plate 21, fig. 8.

Shell small, thin, white, with six well-rounded whorls exclusive of the (lost) nucleus, suture appressed, distinct, undulated by the sculpture; spiral sculpture variable sometimes with well marked threads (six on the last whorl) and a finer intercalary thread in the rather wide interspaces, and sometimes with the spirals obsolete or absent; when present the suture may have a thickened edge with one thread on the preceding whorl immediately behind it, or it may be quite simple; axial sculpture of (on the penultimate whorl about a dozen) short, subnodulous, slightly oblique ribs which do not cross the anal fasciole and become obsolete on the base, separated by narrower interspaces; anal fasciole slightly excavated, smooth except for incremental arcuate lines close to the suture; aperture narrow, anal sulcus wide and deep; outer lip thin, sharp,

prominently arcuately produced; inner lip erased, pillar short, attenuated in front, gyrate; axis pervious; canal narrow, short, slightly recurved. Height of shell, 7.7; of last whorl, 6; diameter, 3.5 mm. Cat. No. 207587, U.S.N.M.

Range.—Station 2792, off Manta, Ecuador, in 401 fathoms, mud, bottom temperature 42.9°; U. S. Bureau of Fisheries.

MANGILIA HAMATA Carpenter.

Mangelia hamata CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 15, p. 399, May, 1865.

Carpenter's type specimen is apparently a fossil and resembles the fossils from the Santa Barbara Pleistocene, where Col. E. Jewett also collected. The rather deep anal sulcus and thickened lip remind one of *Cytharella.*

Range.—"Panama," Colonel Jewett. Cat. No. 15951, U.S.N.M.

MANGILIA CESTA, new species.

Plate 21, fig. 7.

Shell small, whitish, polished, with (on the last whorl six or seven) widely spaced narrow brown spiral lines; whorls six without the (lost) nucleus; suture distinct, axial sculpture of ten rounded ribs extending across the whorl with subequal or wider interspaces; the ribs are not shouldered and start from the suture which they undulate; spiral sculpture of incised lines in the interspaces between the ribs, the brown color is situated in these grooves of which there are six or more on the last whorl, rather widely spaced; aperture simple, anal sulcus inconspicuous, canal very short and wide. Height of shell, 7; of last whorl, 4; diameter, 3 mm. Cat. No. 209040, U.S.N.M.

Range.—San Pedro, California, Mrs. Blood.

This shell resembles *Cytharella,* but lacks the peculiar spiral sculpture and shouldered whorls.

MANGILIA NEWCOMBEI, new species.

Plate 21, fig. 4.

Shell small, brownish, with a tendency to banding, paler at the shoulder and on the base, with six whorls, including a small, smooth nuclear whorl; suture distinct, slightly appressed, with no fasciolar constriction; spiral sculpture of fine flattish threads separated by narrow striae very minutely reticulated by the incremental lines and most conspicuous in the intervals between the ribs, practically covering the whole surface of the shell; axial sculpture, beside almost microscopic lines of growth, of (on the last whorl 14) short rounded ribs, slightly angulated at the shoulder and extending from the suture to the canal with subequal interspaces; anal sulcus shallow, aperture narrow, simple, inner lip erased, canal short, straight.

Height of shell, 11; of last whorl, 7; diameter, 4 mm. Cat. No. 150965, U.S.N.M.

Range.—Clayoquot, Vancouver Island, to Drakes Bay, California.

MANGILIA ? DEJANIRA, new species.

Plate 20, fig. 12.

Shell small, brownish, with an acute brown nucleus of four and a half regularly increasing whorls (apparently smooth but slightly eroded), changed abruptly into the sculpture of the five subsequent whorls; axial sculpture of (on the last whorl 10) low rounded ribs with wider interspaces, obsolete on the base and incremental sculpture indicated by the rather distant sharp striae; spiral sculpture of (on the spire two, on the last whorl three) rather prominent nodules on the ribs with no conspicuous cord in the corresponding part of the interspaces; otherwise the spiral sculpture, especially on the latter whorls, comprises sharp narrow grooves with wider flattened interspaces which become more cordlike on the earlier whorls and the base; whorls moderately rounded with no indication of an anal fasciole, the suture distinct but not appressed, aperture in the type-specimen elongate ovate with simple pillar and thin sharp outer lip, the canal short, deep, forming a distinct but small siphonal fasciole and slightly recurved. Height of shell, 11; of last whorl, 5; diameter, 4.5 mm. Cat. No. 267724, U.S.N.M.

Range.—Dredged in Santa Maria Bay, Lower California; Dr. Paul Bartsch.

This species may prove to be a young *Glyphostoma*, but its peculiar incised sculpture will enable it to be distinguished from the other species of the genus. The absence of an anal fasciole, however, would seem to remove it from that group.

MANGILIA ? EURYBIA, new species.

Plate 22, fig. 2.

Shell small, white, with a very pale yellowish periostracum, a smooth inflated nucleus of a whorl and a half and about four subsequent whorls; the first normal whorl has a small peripheral keel, the next two have ribs in addition, the last whorl has only spiral sculpture; suture distinct, not appressed, the whorls well rounded with the anal fasciole close to the suture; spiral sculpture at first of one or two strong threads in the space between the keel and the succeeding suture, on the last whorl the keel is reduced to a flattish cord with four others in front of it, with wider interspaces; on the anterior part of the base and on the canal are feebler closer threads; axial sculpture confined to the spire of about a dozen short obliquely protractive riblets, most conspicuous where they cross the ribs and with subequal interspaces; on the last whorl they disappear; incre-

mental lines feeble; anal fasciole flat with faint spiral lines crossing arcuate lines of growth; anal sulcus wide and shallow; aperture subovate, outer lip thin, sharp; inner lip erased; pillar short, smooth; axis pervious, canal distinct, wide, with no siphonal fasciole. Height of shell, 7; of last whorl, 4.5; diameter, 3 mm. Cat. No. 211762, U.S.N.M.

Range.—Station 2936, off Cape San Quentin, Lower California, in 359 fathoms, mud, bottom temperature 49° F.; U. S. Bureau of Fisheries.

The enlarged figure of this little species is curiously like a *Chrysodomus.*

ZETEKIA DENTICULATA Dall.

Plate 1, fig. 1.

Zetekia denticulata DALL, Proc. U. S. Nat. Mus., vol. 54, No. 2238, p. 320, 1918.

Shell small, fusiform, purplish brown, with a very small smooth translucent nucleus of about three whorls, and four subsequent whorls; suture obscure, closely appressed; spiral sculpture of (between the sutures six) flattish equal close-set uniform cords, of which there are about 14 on the last whorl, with a few smaller threads on the canal; these cords are cut into squarish granules by numerous narrow axial grooves the interspaces on the earlier whorls having a somewhat riblike aspect; this sculpture is fairly uniform over the entire shell except the nucleus; there is no evident anal fasciole; aperture narrow, anal sulcus prominent, rounded; outer lip internally thickened and with about six short coarse lirae; inner lip callous, with four or five short lirations on the pillar, canal very short, deeply cut, contracted. Height of shell, 6; of last whorl, 3.5; diameter, 2 mm. Cat. No. 274109, U.S.N.M.

Range.—In beach drift at Panama; James Zetek.

This shell, though apparently Pleurotomoid, has much the appearance of a *Mitromorpha*, of which the type is *M. filosa* Carpenter,[1] not *M. lirata* A. Adams, as stated by Fischer and Cossmann. The genus is described correctly by Adams as having a single inconspicuous plait anteriorly on the pillar. This plait only appears in completely adult individuals, as do the small internal denticulations of the outer lip. There is no notch at the posterior commissure of the aperture in any of the California species, nor is one mentioned by Adams in the description of *M. lirata* from Japan. The present species has a conspicuous notch but no plication properly speaking on the pillar, only small pustular lirations on the outer edge of the columellar callosity. Cossmann gives the genus two strong plaits on

[1] Ann. Mag. Nat. Hist., vol. 15, March, 1865, p. 182, sole species *M. filosa* Carpenter. A. Adams's description was printed in the April number, p. 322.

the pillar, which, with his figure, indicate that he had a species of *Mitra* in hand, from which his diagnosis was made.

The present species seems entitled to a distinct group name.

DAPHNELLA BARTSCHI, new species.

Plate 19, figs. 4, 5.

Shell small, slender, yellowish white with brown flames and flecks, moderately convex whorls, distinct suture, and six whorls, with a very minute brown nucleus of two whorls; the whole surface is delicately reticulated with subequal axial and spiral threads, the spirals cut by the axial interspaces into minute nodules, the interstices squarish; the surface resulting is grating to the touch; the aperture is narrow, the canal hardly differentiated and not recurved. Height of shell, 8.5; of last whorl, 6; diameter, 5 mm. Cat. No. 267341, U.S.N.M.

Range.—Lower California and the Gulf of California; Dr. Paul Bartsch.

This is much smaller and with more delicate and even sculpture than the related species *D. casta* Hinds, and *D. clathrata* Gabb, both of which have much larger nuclei. *D. effusa* Carpenter from Neeah Bay, Washington, was founded on a broken and worn unidentifiable specimen probably not even belonging to the genus *Daphnella* *D. electra* Dall is a still smaller and differently colored species, and *D. fuscoligata* Dall has quite a different sculpture and may possibly be a *Clathromangilia.*

CYTHARELLA ACULEA, new species.

Shell small, purple brown, banded with white, or varicolored; nucleus of one and a half loosely coiled, smooth nuclear, and four subsequent whorls; axial sculpture of six, somewhat sigmoid rounded ribs continuous up the spire, with excavated, much wider interspaces, with fine axial striation, which slightly wrinkles the spirals; spiral sculpture of numerous sharp, often paired grooves separated by wider flattish interspaces which are faintly marked by the axial striation; aperture narrow, anal sulcus conspicuous, outer lip thickened, smooth inside, pillar simple, canal hardly differentiated. Height of shell, 6; of last whorl, 3.5; diameter, 2 mm. Cat. No. 73994, U.S.N.M.

Range.—San Diego, California, to Cape San Lucas.

Though small, this is one of the most elegant of the West Coast species. The name was suggested by Doctor Carpenter. Some specimens are more slender than others, and the coloration is variable.

CYTHARELLA SUBDIAPHANA Carpenter.

Plate 24, fig. 4.

Mangelia subdiaphana CARPENTER, Ann. Mag. Nat. Hist., ser. 3, vol. 15, p. 45, July, 1864.

Range.—Cape San Lucas; J. Xantus.

The specimen figured is Carpenter's type, Cat. No. 274104, U.S.N.M. This is one of the species with an elevated spire which approaches *Philbertia.*

CYTHARELLA LOUISA, new species.

Plate 24, fig. 3.

Shell minute, nucleus with a small apex, the whorl later swollen, the second turn with three strong spiral threads, the following three whorls with 11 or 12 axial ribs with subequal interspaces and no pronounced shoulder; spiral sculpture between the sutures of three strong subequal flattish threads somewhat swollen when they override the ribs, and with a few much finer threads in the interspaces between the major threads; the spaces between the reticulation on the earlier whorls are deep and have a pitlike aspect; near the suture in fresh specimens is a dark spiral band extending to the rounded shoulder, in front of which the shell is yellowish white with (on the last whorl) four or five narrow brown spiral lines with much wider interspaces; aperture moderately wide with a very shallow ill-defined sulcus, the outer lip thickened, smooth, the canal wide, not differentiated from the aperture, the inner lip smooth. Height of shell, 4.25; of last whorl, 2.7; diameter, 1.7 mm. Cat. No. 160122, U.S.N.M.

Range.—San Luis Obispo, California, Mrs. Dial.

CYTHARELLA QUADRISERIATA, new species.

Plate 24, fig. 8.

Shell small, stout, blunt, white, with a brown peripheral band and another on the base; nucleus small, blunt, at first smooth and then spirally striated, in all about two whorls followed by five subsequent whorls; axial sculpture of eight rounded ribs, partly continuous up the spire, undulating the suture and with subequal interspaces; faint lines of growth cross the transverse sculpture; spiral ornamentation of almost microscopically fine threads uniform over the shell, with wider flat interspaces; aperture short and wide with no differentiated canal; anal sulcus conspicuous, outer lip thickened, smooth inside. Height, 5; of last whorl, 3; diameter, 2 mm. Cat. No. 55503, U.S.N.M.

Range.—Gulf of California to Acapulco.

This belongs to the same general group as *C. aculea*, but has quite distinct sculpture and is stouter in proportion. Like that species it is variable in its coloration.

CYTHARELLA HIPPOLITA, new species.

Plate 22, figs. 6, 8.

Shell small, slender, whitish, dark brown, or spirally banded with brown and white; nucleus with a very small blunt apical whorl, the succeeding whorl (worn in the specimens) probably feebly sculptured; subsequent whorls about five, with an appressed suture: spiral sculpture of very fine spiral striae, perceptible under magnification, becoming coarser toward the canal; axial sculpture (including the terminal varix) of seven strong ribs with wider interspaces, slightly protractive anteriorly, continuous up the spire around which they show a slight twist, and extending on the last whorl to the canal; aperture narrow, elongated, anal sulcus wide, shallow, outer lip thickened, smooth internally, inner lip simple: canal hardly differentiated. Height of shell, 5.7; of last whorl, 3.5 diameter, 2 mm. Cat. No. 127536, U.S.N.M.

Range.—Shell drift at San Hipolito Point, Lower California, and also at San Diego, California; Hemphill.

Much like *C. aculea*, but constantly stouter and shorter, with one more rib and coarser striation.

CYTHARELLA VERDENSIS, new species.

Shell small, short-fusiform, whitish or feebly dotted with brown, with three brown nuclear and four subsequent whorls: apex of the nucleus very small, smooth, the other two microscopically rugose; suture appressed behind a faint anal fasciole, whorls moderately rounded; spiral sculpture uniform, of fine attenuated close-set spiral threads covering the whole surface and crossed by minutely sharp incremental lines giving a peculiarly rough effect: other axial sculpture of (on the last whorl about 12) rather feeble rounded ribs obsolete anteriorly with about equal interspaces: aperture elongate, narrow with no differentiated canal; the outer lip moderately varicose, sharp-edged, smooth within, the anal sulcus rounded, shallow, close to the suture. Height of shell, 6.5: of last whorl, 5: diameter, 3 mm. Cat. No. 266336, U.S.N.M.

Range.—Agua Verde Bay, Lower California. Dr. Paul Bartsch.

? CYTHARELLA JANIRA, new species.

Plate 21, fig. 10.

Shell small, acute, white or waxen, with a small smooth nucleus of about two whorls and five subsequent moderately rounded whorls; suture distinct, hardly appressed: spiral sculpture of sharp striae

with wider minutely striated interspaces, over the whole surface, not swollen where they pass over the ribs; the whorls are slightly shouldered, there are about three or four of the straplike interspaces on the spire between the shoulder and the succeeding suture, behind the shoulder they are less obvious and the sculpture less coarse; on the last whorl the sculpture is quite uniform; axial sculpture of nine or ten protractively oblique slightly sigmoid ribs which nearly reach the canal and on the spire extend from suture to suture; aperture narrow, the anal sulcus wide and shallow, close to the suture, the outer lip is thickened but not internally lirate; the inner lip smooth; the canal is short, wide, and hardly differentiated from the rest of the aperture. Height of shell, 9; of last whorl, 6; diameter, 3 mm. Cat. No. 55285, U.S.N.M.

Range.—San Diego, California, Stearns collection.

It is possible this may be a *Mangilia* with unusually thickened lip. or an immature *Cytharella.*

CYTHARELLA ELECTRA, new species.

Shell minute, waxen white, sometimes with faint purplish spiral bands, with two and a half nuclear and four and a half subsequent reticulate whorls; nucleus turbinate, the first two whorls smooth, polished, brown, the remainder axially minutely ribbed, the sculpture passing into that of the normal subsequent whorls; suture distinct, not appressed; spiral sculpture between the succeeding suture and the fasciole on the spire, of four equal and equally spaced threads with slightly wider interspaces; rarely the posterior thread is more prominent than the others; on the last whorl there are about nine threads, more adjacent as they approach the canal which has about six more closely set; axial sculpture of (on the last whorl about 14) low narrow straight ribs extending from the suture to the canal with slightly narrower interspaces; there is no nodulation at the intersections with the spiral sculpture and the reticulations are squarish and deep; aperture narrow, anal sulcus shallow, rounded, conspicuous; outer lip varicose, sharp edged, not lirate within; inner lip erased, canal hardly differentiated. Height of shell, 5.5; of last whorl, 3.7; diameter, 2 mm. Cat. 267706, U.S.N.M.

Range.—Head of Concepcion Bay, Gulf of California, Dr. Paul Bartsch.

The general aspect except for the sulcus is that of a *Mitromorpha.*

CYTHARELLA NIOBE, new species.

Plate 23, figs. 4, 5.

Shell small, whitish, with or without pale bands or clouds of light brown, fusiform, the nucleus with a minute smooth translucent apex, the succeeding whorl sharply spirally striated, this sculpture followed by minute reticulation for about half a whorl and then by the

normal adult sculpture on five succeeding whorls; spiral sculpture of fine equal close-set threads, covering the posterior half of the whorl and on the anterior half similar but slightly larger threads, while on the fourth whorl there is one, on the fifth and sixth whorls two, and on the last whorl three, slightly larger threads near the periphery which are somewhat swollen where they override the ribs; between the peripheral pair of these are three or four of the minor threads; axial sculpture of eight rounded nearly vertical ribs extending from suture to suture on the spire and nearly to the canal on the last whorl with subequal interspaces, not continuous over the suture which is distinct and not appressed; the whorls are moderately convex; aperture rather narrow, the anal sulcus proportionately large and rounded, the outer lip varicose and infolded, with a sharp edge; the throat smooth, white; the inner lip smooth, the pillar very short, straight, the canal hardly differentiated. Height of shell, 6.5; of last whorl, 5; diameter, 2.2 mm. Cat. No. 274105, U.S.N.M.

Range.—Panama, in beach drift; James Zetek.

CYTHARELLA AMATULA, new species.

Plate 21, fig. 2.

Shell small, pale waxen yellow, with occasional brown spots between the ribs, with about one and a half smooth white nuclear and about five and a half subsequent whorls; axial sculpture of (on the last whorl eight) stout protractively arcuate ribs with subequal or narrower interspaces not continuous up the spire, but extending from the suture over a slight shoulder to the canal; spiral sculpture of numerous fine sharp striae covering the shell (except on the anal fasciole) with flattish wider interspaces; there is a slight angle at the shoulder; aperture narrow, the outer lip infolded, the anal sulcus large, the canal hardly differentiated, the pillar smooth. Height, 6.5; diameter, 3.0 mm. Cat. No. 127534*a*, U.S.N.M.

Type-locality.—San Diego, California.

This is one of the species which approaches in form the *Mangilia* type.

CYTHARELLA PHAETHUSA, new species.

Plate 24, fig. 1.

Shell minute, with a very small turbinate brown nucleus of about two and a half whorls, the latter part of which is feebly reticulately sculptured, and three and a half subsequent whorls; suture distinct, not appressed, whorls moderately rounded, whitish with a pinkish brown banded base; spiral sculpture of (on the first whorl one, on the second two) peripheral strong threads, on the last whorl four with much wider striated interspaces; these threads on dead specimens show paler than the general surface; on the base and canal are about a dozen smaller close-set threads; none of the threads

are nodulose where they cross the ribs; axial sculpture of (on the last whorl eight) narrow sigmoid ribs, with wider interspaces, extending from suture to canal across the last whorl; the aperture narrow, the outer lip varicose, smooth within; the inner lip simple, not callous; the anal sulcus large and shallow, the pillar straight, the canal hardly differentiated. Height of shell, 3.25; of last whorl, 2; diameter, 1.25 mm. Cat. Nos. 269171 and 268038*b*, U.S.N.M.

Range.—Head of Concepcion Bay, Lower California, Dr. Paul Bartsch.

Many of the specimens have the last whorl conspicuously striped with brown. The dead specimens are often slaty with pale spiral threads. There is also some variation in stoutness and in the strength of the posterior thread which in a few specimens is stronger than the others giving a slight shoulder to the whorl.

CYTHARELLA (AGATHOTOMA) PYRRHULA, new species.

Plate 24, fig. 6.

Shell small, brownish with a white peripheral band, brilliantly polished; with a pointed nucleus of two smooth rounded and one peripherally sharply keeled whorls; and about six subsequent whorls; suture distinct, appressed, fasciole constricted; spiral sculpture of about a dozen grooves with wider interspaces on the base and canal; axial sculpture of (on the last whorl 13) narrow sigmoid ribs extending from the fasciole to the canal with somewhat wider smooth interspaces; aperture contracted, anal sulcus large, with flaring margin and subsutural callus; outer lip sharp edged, infolded, a prominent varix behind it, and under the varix internally a thickened ridge with about five short oblique lirae; inner lip erased; pillar longer with about six lirae; canal short, deep, moderately recurved. Height of shell, 11; of last whorl, 6.5; diameter, 5 mm. Cat. No. 96590, U.S.N.M.

Range.—Station 2830, off Lower California, northwest of Cape San Lucas, in latitude 23° 33′ N., in 66 fathoms, sand. U. S. Bureau of Fisheries.

CYTHARELLA (AGATHOTOMA) EURYCLEA, new species

Plate 24, figs. 5, 11.

Shell minute, whitish or pale brownish, subcylindric, turrited, the nucleus with a projecting minute subglobular apex and about one and a half smooth whorls followed by about four and a half sculptured whorls; spiral sculpture of minute close-set threads covering uniformly the whole surface; suture distinct, appressed, the whorls shouldered immediately in front of it; axial sculpture of (on the last whorl seven or eight) prominent, slightly protractively oblique ribs, with wider interspaces, extending over the whole whorl and

prominent at the shoulder, but not continuous over the spire; aperture narrow, outer lip varicose, thick, striated in front, smooth within, the anal sulcus conspicuous but not deep; inner lip smooth, the canal hardly differentiated. Height of shell, 5; of last whorl, 3.5; diameter, 1.75 mm. Cat. Nos. 268908 and 267640, U.S.N.M.

Range.—Dredged at Agua Verde Bay and the head of Concepcion Bay, Lower California, Dr. Paul Bartsch.

CYTHARELLA (AGATHOTOMA) PENELOPE, new species.

Plate 24, fig. 10.

Shell minute, pale brownish, or whitish with obscure brownish spiral bands, with a minute trochoid nucleus of three whorls the earlier smooth, the last axially minutely closely ribbed, followed by five subsequent whorls; suture distinct, hardly appressed, the whorl sloping steeply away from it; spiral sculpture of fine close-set threads over the entire surface; whorls moderately convex; axial sculpture of (on the last whorl six) prominent ribs, with much wider interspaces, extending the whole length of the whorl and on the spire more prominent at the periphery; aperture narrow, parallel-sided, the outer lip varicose, smooth within, the anal sulcus wide and shallow, the canal hardly differentiated. Height of shell, 5; of last whorl, 3; diameter, 2 mm. Cat. No. (268908*a*) 266346, U.S.N.M.

Range.—Agua Verde Bay, Lower California, Dr. Paul Bartsch.

Some specimens are slightly larger, others smaller.

CYTHARELLA (AGATHOTOMA) CAMARINA, new species.

Plate 24, fig. 9.

Shell small, white, hexagonal, with a blunt glassy nucleus of a whorl and a half and about five subsequent whorls; surface showing no spiral sculpture under a hand lens; axial sculpture of six strong rounded ribs, running the whole length of the shell and continuous over the spire; suture distinct; aperture narrow, with a relatively large rounded anal sulcus, a thickened outer lip without internal liration, the inner lip simple not callous, the pillar short, the canal hardly differentiated. Height of shell, 6; of last whorl, 4.5; diameter, 2.5 mm. Cat. No. 122125, U.S.N.M.

Range.—Indefatigable Island, Galapagos Islands, on the beach. U. S. Bureau of Fisheries.

CYTHARELLA (AGATHOTOMA) PHRYNE, new species.

Plate 24, fig. 12.

Shell small, fusiform, short, stout, whitish, with three obscure pale brownish spiral bands on the last whorl; nucleus minute, translucent, of about one whorl with somewhat over four subsequent whorls; suture appressed, obscure; spiral sculpture of numerous very fine equal close-set threads over the whole surface; axial sculp-

ture of seven strong rounded somewhat sigmoid ribs, slightly shouldered near the suture, continuous up the spire and obliquely retractive posteriorly; there are no obvious incremental lines; the ribs extend from the canal to the suture on the last whorl; aperture narrow, anal sulcus shallow, rounded; outer lip broadly infolded, smooth within; inner lip smooth, not callous, canal hardly differentiated. Height of shell, 6.2; of last whorl, 4; diameter, 2.5 mm. Cat. No. 274106, U.S.N.M.

Range.—In beach drift at Panama, James Zetek.

TARANIS PANOPE, new species.

Plate 9, fig. 2.

Shell small, of about six whorls including the blunt (defective) nucleus, white with pale olivaceous periostracum, short and stumpy; earlier whorls with two strong peripheral keels and a thread upon which the suture is laid; last whorl with a cord at the suture and on the other side of the anal fasciole about five elevated keels with subequal interspaces, more adjacent on the base with about as many more smaller and closer threads on the anterior region; suture appressed, obscure; anal fasciole concave, not spirally striated; axial sculpture of rather close sharp striae which cut the spirals; aperture narrow, anal sulcus deep, rounded; outer lip greatly produced, thin, smooth within, inner lip with a wash of callus, canal distinct but very short. Height of shell, 4.5; of last whorl, 2.6; diameter, 2.3 mm. Cat. No. 207577, U.S.N.M.

Range.—Station 2792, off Manta, Ecuador, in 401 fathoms, mud, bottom temperature 42.9° F. U. S. Bureau of Fisheries.

TARANIS ZEUXIPPE, new species.

Plate 3, fig. 3.

Shell minute, white or warm brown, with a turbinate nucleus having a minute smooth apex and three later axially concavely arcuate ribbed whorls; subsequent whorls three and a half with a distinct suture; spiral sculpture between the sutures of two prominent keels and an anterior smaller one on which the suture is laid; on the last whorl there are about eight minor threads in front of those mentioned, all with wider interspaces; axial sculpture of prominent oblique lines protractively cutting the interspaces; anal sulcus shallow, distinct, close to the suture; outer lip thin, slightly produced, inner lip erased; pillar short, straight, canal hardly differentiated. Height of shell, 3.8; of last whorl, 2.2; diameter, 2 mm. Cat. No. 194965, U.S.N.M.

Range.—Station 2813, among the Galapagos Islands, in 40 fathoms, sand. temperature at surface 81° F. U. S. Bureau of Fisheries.

REFERENCES TO GROUPS.

Agathotoma, p. 79.
Antiplanes, p. 33.
Bellaspira, p. 29.
Borsonella, p. 37.
Carinodrillia, p. 17.
Clathrodrillia, p. 14.
Clathromangilia, p. 62.
Crassispira, p. 21.
Cryptogemma, p. 30.
Cymatosyrinx, p. 6.
Cytharella, p. 74.
Daphnella, p. 74.
Elaeocyma, p. 9.
Glyphostoma, p. 52.
Haedropleura, p. 30.
Knefastia, p. 3.
Kurtziella, p. 62.
Kylix, p. 19.
Laevitectum, p. 19.
Leucosyrinx, p. 5.
Lora, p. 39.
Mangilia, p. 62.
Moniliopsis, p. 27.
Nannodiella, p. 59.
Philbertia, p. 54.
Pleurotomella, p. 50.
Pseudomelatoma, p. 21.
Suavodrillia, p. 29.
Surcula, p. 3.
Taranis, p. 81.
Turricula, p. 2.
Zetekia, p. 73.

EXPLANATION OF PLATES.

PLATE 1.

FIG. 1. *Zetekia denticulata* Dall, Alt. 6 mm.; p. 73.
2. *Mangilia nunivakensis* Dall, Alt. 18 mm.; p. 65.
3. *Elaeocyma aerope* Dall, Alt. 16 mm.; p. 13.
4. *Turricula* (*Surcula*) *laysanica* Dall. Alt. 52 mm.; p. 3.
5. *Turricula* (*Surcula*) *panthea* Dall, Alt. 47 mm.; p. 4.
6. *Turricula* (*Surcula*) *lavinia* Dall, Alt. 49 mm.; p. 4.

PLATE 2.

FIG. 1. ? *Clathrodrillia castianira* Dall, Alt. 10 mm.; p. 15.
2. *Clathrodrillia andromeda* Dall, Alt. 16.5 mm.; p. 16.
3. *Clathrodrillia* (*Kylix*) *alcyone* Dall, Alt. 15 mm.; p. 20.
4. *Clathrodrillia resina* Dall, Alt. 50 mm.; p. 16.
5. *Turricula libya* Dall, Alt. 40 mm.; p. 2.
6. *Turricula nigricans* Dall, Alt. 38 mm.; p. 3.

PLATE 3.

FIG. 1. *Elaeocyma acolia* Dall, Alt. 7 mm.; p. 11.
2. ? *Leucosyrinx galapagana* Dall, Alt. 20 mm.; p. 5.
3. *Taranis zeuxippe* Dall, Alt. 3.8 mm.; p. 81.
4. *Pleurotomella thalassica* Dall, Alt. 10 mm.; p. 51.
5. *Pleurotomella oceanida* Dall. Alt. 12 mm.; p. 51.
6. *Pleurotomella herminea* Dall, Alt. 19 mm.; p. 50.
7. *Leucosyrinx amycus* Dall, Alt. 52 mm.; p. 5.
8. *Leucosyrinx kincaidi* Dall, Alt. 29 mm.; p. 6.

PLATE 4.

FIG. 1. *Elaeocyma empyrosia* Dall, Alt. 31 mm.; p. 12.
2. *Elaeocyma aegina* Dall, Alt. 13 mm.; p. 12.
3. *Elaeocyma arbela* Dall, Alt. 13.7 mm.; p. 10.
4. *Elaeocyma halocydne* Dall, Alt. 18 mm.; p. 11.
5. *Elaeocyma abdera* Dall, Alt. 15 mm.; p. 12.
6. *Elaeocyma ianthe* Dall, Alt. 17 mm.; p. 9.

PLATE 5.

FIG. 1. *Clathrodrillia paziana* Dall, Alt. 13 mm.; p. 14.
2. *Clathrodrillia callianira* Dall, Alt. 16 mm.; p. 16.
3. *Clathrodrillia* (*Carinodrillia*) *thestia* Dall, Alt. 14 mm.; p. 18.
4. *Clathrodrillia* (*Carinodrillia*) *halis* Dall, Alt. 20 mm.; p. 17
5. *Clathrodrillia* (*Carinodrillia*) *haliplexa* Dall, Alt. 27 mm.; p. 19.
6. *Clathrodrillia* (*Carinodrillia*) *alcestis* Dall, Alt. 30 mm.; p. 18.

PLATE 6.

FIG. 1. *Crassispira bacchia* Dall, Alt. 14.5 mm.; p. 25.
2. *Crassispira amathea* Dall, Alt. 22 mm.; p. 27.
3. *Crassispira dirce* Dall, Alt. 23.5 mm.; p. 22.
4. *Crassispira arsinoë* Dall, Alt. 17 mm.; p. 26.
5. *Crassispira tepocana* Dall, Alt. 19 mm.; p. 25.
6. *Crassispira candace* Dall, Alt. 7 mm.; p. 22.

PLATE 7.

FIG. 1. *Crassispira nephele* Dall, Alt. 13 mm.; p. 23.
2. *Crassispira appressa* Carpenter, Alt. 7.5 mm.: p. 22.
3. *Lora brachis* Dall, Alt. 4.5 mm.; p. 41.
4. *Crassispira epicasta* Dall, Alt. 9 mm.; p. 24.
5. *Crassispira eurynome* Dall, Alt. 10 mm.; p. 21.
6. *? Crassispira rugitecta* Dall, Alt. 30.5 mm.; p. 26.
7. *Crassispira bridgesi* Dall, Alt. 11 mm.; p. 24.
8. *Crassispira erigone* Dall, Alt. 20.6 mm.; p. 21.

PLATE 8.

FIG. 1. *Moniliopsis halcyonis* Dall, Alt. 23 mm.; p. 29.
2. *Moniliopsis grippi* Dall, Alt. 27 mm.; p. 27.
3. *Moniliopsis fancherae* Dall, Alt. 10.5 mm.; p. 28.
4. *Cymatosyrinx ferminiana* Dall, Alt. 14.2 mm.; p. 7.
5. *Moniliopsis rhines* Dall, Alt. 18 mm.; p. 28.
6. *Mangilia oenoa* Dall, Alt. 6.5 mm.; p. 66.

PLATE 9.

FIG. 1. *Antiplanes amphitrite* Dall, Alt. 13.5 mm.; p. 37.
2. *Taranis panope* Dall, Alt. 4.5 mm.; p. 81.
3. *Cryptogemma cymothoë* Dall, Alt. 9 mm.; p. 31.
4. *Cryptogemma polycaste* Dall, Alt. 13.5 mm.; p. 30.
5. *Antiplanes abarbarea* Dall, Alt. 21.5 mm.; p. 35.
6. *Antiplanes hyperia* Dall, Alt. 12 mm.; p. 35.
7. *Cryptogemma polycaste* Dall, Alt. 14.9 mm.; adult, aperture defective, p. 30.
8. *Cryptogemma calypso* Dall, Alt. 11 mm.; p. 31.
9. *Cryptogemma quentinensis* Dall, Alt. 12 mm.; p. 32.

PLATE 10.

FIG. 1. *Antiplanes kamchatica* Dall, Alt. 51 mm.; p. 33.

PLATE 11.

FIG. 1. *Antiplanes litus* Dall, Alt. 16 mm.; p. 34.
2. *Cryptogemma chrysothemis* Dall, Alt. 16.5 mm.; p. 31.
3. *Antiplanes santarosana* Dall, Alt. 36 mm.; p. 36.
4. *Cryptogemma antigone* Dall, Alt. 23 mm.; p. 32.
5. *Antiplanes amycus* Dall, Alt. 21.5 mm.; p. 36.
6. *Antiplanes thalaea* Dall, Alt. 40 mm.; p. 37.
7. *Antiplanes bulimoides* Dall, Alt. 31 mm.; p. 34.

PLATE 12.

FIG. 1. *Borsonella nicoli* Dall, Alt. 22 mm.; p. 39.
2. *Borsonella nychia* Dall, Alt. 12 mm.; p. 38.
3. *Borsonella rhodope* Dall, Alt. 19 mm.; p. 39.
4. *Borsonella omphale* Dall, Alt. 16 mm.; p. 38.
5. *Moniliopsis ophioderma* Dall, Alt. 38 mm.; p. 28.
6. *Borsonella barbarensis* Dall, Alt. 29 mm.; p. 37.
7. *Moniliopsis incisa* Carpenter, Alt. 38 mm.; p. 28.

PLATE 13.

FIG. 1. *Philbertia crystallina* Gabb, Alt. 7.7 mm.; p. 62.
2. *?Lora equatorialis* Dall, Alt. 13.5 mm.; p. 44.
3. *Clathrodrillia limans* Dall, Alt. 7 mm.; p. 14.
4. *?Crassispira martinensis* Dall, Alt. 18 mm.; p. 27.
5. *Laevitectum eburneum* Carpenter, Alt. 30 mm.; p. 19.
6. *Lora rugulata* Troschel, Alt. 16 mm.; p. 50.

PLATE 14.

FIG. 1. *Lora tabulata* Carpenter, Alt. 11 mm.; p. 45.
2. *Lora miona* Dall, Alt. 8 mm.; p. 47.
3. *Lora kyskana* Dall, Alt. 10.5 mm.; p. 47.
4. *Lora lotta* Dall, Alt. 7.5 mm.; p. 47.
5. *Lora excurvata* Carpenter, Alt. 7.2 mm.; p. 46.
6. *Lora surana* Dall, Alt. 9 mm.; p. 45.
7. *Lora chiachiana* Dall, Alt. 20 mm.; p. 43.
8. *Lora popovia* Dall, Alt. 13 mm.; p. 42.
9. *Lora pavlova* Dall, Alt. 18.5 mm.; p. 43.

PLATE 15.

FIG. 1. *Lora regulus* Dall, Alt. 8 mm.; p. 48.
2. *Lora quadra* Dall, Alt. 8 mm.; p. 46.
3. *Lora krausei* Dall, Alt. 9.5 mm.; p. 46.
4. *Lora tenuilirata* Dall, Alt. 22 mm.; p. 42.
5. *Lora tenuissima* Dall, Alt. 15 mm.; p. 49.
6. *Lora lawrenciana* Dall, Alt. 13 mm.; p. 43.
7. *Lora alitakensis* Dall, Alt. 20 mm.; p. 43.
8. *Lora nazanensis* Dall, Alt. 11 mm.; p. 45.
9. *Lora montercalis* Dall, Alt. 12 mm.; p. 46.

PLATE 16.

FIG. 1. *Lora mitrata* Dall, Alt. 24 mm.; p. 43.
2. *Lora colpoica* Dall, Alt. 11 mm.; p. 50.
3. *Lora pribilova* Dall, Alt. 12 mm.; p. 44.
4. *Lora tenuilirata cymata* Dall, Alt. 23 mm.; p. 42.

5. *Lora lütkeni* Dall, Alt. 8 mm.; p. 48.
6. *Lora halitropa* Dall, Alt. 6 mm.; p. 40.
7. *Lora pitysa* Dall, Alt. 5.5 mm.; p. 40.
8. *Lora healyi* Dall, Alt. 15 mm.; p. 42.
9. *Lora inequita* Dall, Alt. 11 mm.; p. 44.
10. *Lora diegensis* Dall, Alt. 8.5 mm.; p. 46.
11. *Lora althorpensis* Dall, Alt. 6.5 mm.; p. 49.
12. *Lora sixta* Dall, Alt. 8 mm.; p. 49.

PLATE 17.

FIG. 1. *Glyphostoma adana* Dall, Alt. 10 mm.; p. 52.
2. *Glyphostoma thalassoma* Dall, Alt. 19.5 mm.; p. 52.
3. *Glyphostoma sirena* Dall, Alt. 10 mm.; p. 53.
4. *Glyphostoma partefilosa* Dall, Alt. 11 mm.; p. 53.
5. *Glyphostoma adria* Dall, Alt. 10 mm.; p. 52.
6. *Glyphostoma cymodoce* Dall, Alt. 11.5 mm.; p. 54.

PLATE 18.

FIG. 1. *Philbertia scammoni* Dall, Alt. 7 mm.; p. 57.
2. *Philbertia helena* Dall, Alt. 3.5 mm.; p. 55.
3. *Philbertia dictynna* Dall, Alt. 3.8 mm.; p. 57.
4. *Philbertia doris* Dall, Alt. 5.2 mm.; p. 55.
5. *Philbertia telamon* Dall, Alt. 4 mm.; p. 58.
6. *Philbertia aethra* Dall, Alt. 8 mm.; p. 57.
7. *Elaeocyma attalia* Dall, Alt. 8.5 mm.; p. 10.
8. *Philbertia aegialea* Dall, Alt. 7 mm.; p. 58.

PLATE 19.

FIG. 1. *Lora antipoda* Dall, Alt. 5 mm.; p. 41.
2. *Cryptogemma adrastia* Dall, Alt. 16 mm.; p. 33.
3. *Philbertia trichodes* Dall, Alt. 4 mm.; p. 62.
4. *Daphnella bartschi* Dall, Alt. 9 mm.; p. 74.
5. *Daphnella bartschi* Dall, another specimen with immature lip, less enlarged, Alt. 9 mm.; p. 74.
6. ? *Mangilia hermione* Dall, Alt. 8 mm.; p. 70.
7. *Cymatosyrinx palmeri* Dall, Alt. 9.5 mm.; p. 8.
8. *Bellaspira melea* Dall, Alt. 12 mm.; p. 29.
9. *Mangilia althorpi* Dall, Alt. 11.5 mm.; p. 68.

PLATE 20.

FIG. 1. *Cymatosyrinx elissa* Dall, Alt. 7 mm.; p. 6.
2. *Cymatosyrinx hespera* Dall, Alt. 9 mm.; p. 6.
3. *Cymatosyrinx lalage* Dall, Alt. 8 mm.; p. 7.
4. *Cymatosyrinx plicatella* Dall, Alt. 7 mm.; p. 7.
5. *Nannodiella fraternalis* Dall, Alt. 4.75 mm.; p. 60.
6. ? *Nannodiella phylira* Dall, immature, Alt. 7 mm.; p. 60.
7. *Nannodiella nana* Dall, Alt. 3.5 mm.; p. 59.
8. *Nannodiella amyela* Dall, immature, Alt. 4.5 mm.; p. 61.
9. *Cymatosyrinx hecuba* Dall, the aperture defective; Alt. 11 mm.; p. 9.
10. *Mangilia* (*Kurtziella*) *hebe* Dall, Alt. 10 mm.; p. 63.
11. *Mangilia perattenuata* Dall, Alt. 10 mm.; p. 65.
12. ? *Mangilia dejanira* Dall, Alt. 11 mm.; p. 72.

PLATE 21.

FIG. 1. *Clathromangilia levidensis* Carpenter, Alt. 17 mm.; p. 62.
2. *Cytharella amatula* Dall, Alt. 6.5 mm.; p. 78.
3. *Clathromangilia rhyssa* Dall, Alt. 7 mm.; p. 62.
4. *Mangilia newcombei* Dall, Alt. 11 mm.; p. 71.
5. *Mangilia* (*Kurtziella*) *cyrene* Dall, Alt. 4.25 mm.; p. 62.
6. *Mangilia* (*Kurtziella*) *danae* Dall, Alt. 4.5 mm.; p. 63.
7. *Mangilia cesta* Dall, Alt. 7 mm.; p. 71.
8. *Mangilia laodice* Dall, Alt. 7.7 mm.; p. 70.
9. ? *Mangilia carlottae* Dall, Alt. 9 mm.; p. 68.
10. *Cytharella janira* Dall, Alt. 9 mm.; p. 76.
11. *Cymatosyrinx idothea* Dall, the aperture defective; Alt. 9 mm.; p. 8.
12. ? *Mangilia carlottae* Dall, variety, Alt. 19 mm.; p. 68.

PLATE 22.

FIG. 1. *Antiplanes briseis* Dall, Alt. 18 mm.; p. 35.
2. ? *Mangilia eurybia* Dall, Alt. 7 mm.; p. 72.
3. *Pseudomelatoma penicillata* Carpenter, Alt. 33 mm.; p. 21.
4. *Mangilia* (*Kurtziella*) *beta* Dall, Alt. 5 mm.; p. 64.
5. *Mangilia* (*Kurtziella*) *roperi* Dall, Alt. 6.5 mm.; p. 64.
6. *Cytharella hippolita* Dall, Alt. 6 mm.; p. 76.
7. *Mangilia philodice* Dall, Alt. 7.5 mm.; p. 66.
8. *Cytharella hippolita* Dall, Alt. 5.7 mm.; p. 76.

PLATE 23.

FIG. 1. *Mangilia eriopis* Dall, Alt. 13.5 mm.; p. 67.
2. *Mangilia evadne* Dall, Alt. 12 mm.; p. 69.
3. *Mangilia painei* Arnold, Alt. 15 mm.; p. 65.
4. *Cytharella niobe* Dall, adult, Alt. 6.5 mm.; p. 77.
5. *Cytharella niobe* Dall, a younger specimen.
6. *Philbertia hilaira* Dall, Alt. 6 mm.; p. 61.

PLATE 24.

FIG. 1. *Cytharella phaethusa* Dall, Alt. 3.25 mm.; p. 78.
2. *Antiplanes agamedea* Dall, Alt. 10.5 mm.; p. 33.
3. *Cytharella louisa* Dall, Alt. 4.25 mm.; p. 75.
4. *Cytharella subdiaphana* Carpenter, Alt. 5 mm.; p. 75.
5. *Cytharella* (*Agathotoma*) *euryclea* Dall, Alt. 5 mm.; p. 79.
6. *Cytharella* (*Agathotoma*) *pyrrhula* Dall, Alt. 11 mm.; p. 79.
7. ? *Haedropleura melita* Dall, Alt. 5.2 mm.; p. 30.
8. *Cytharella quadriseriata* Dall, Alt. 5 mm.; p. 75.
9. *Cytharella* (*Agathotoma*) *camerina* Dall, Alt. 6 mm.; p. 80.
10. *Cytharella* (*Agathotoma*) *penelope* Dall, Alt. 5 mm.; p. 80.
11. *Cytharella* (*Agathotoma*) *euryclea* Dall, variety, Alt. 5 mm.; p. 79.
12. *Cytharella* (*Agathotoma*) *phryne* Dall, Alt. 6 mm.; p. 80.

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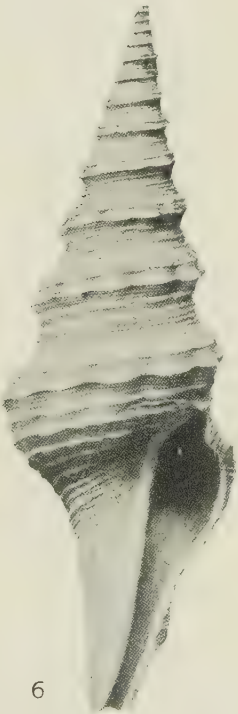

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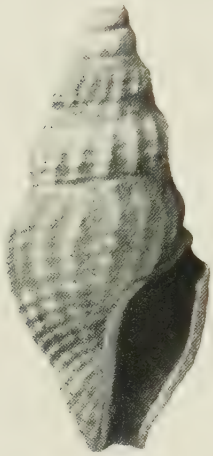
NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 82



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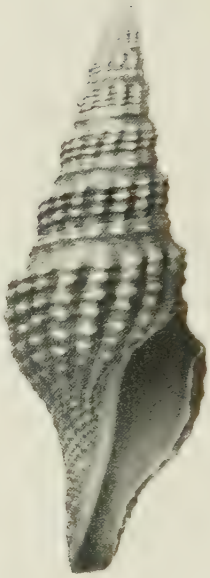

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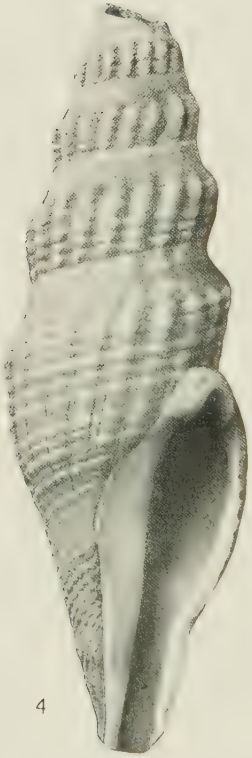

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 82

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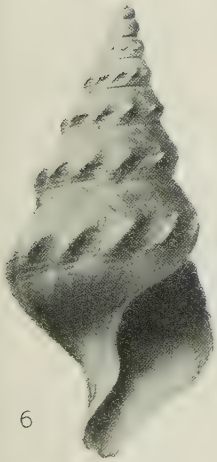

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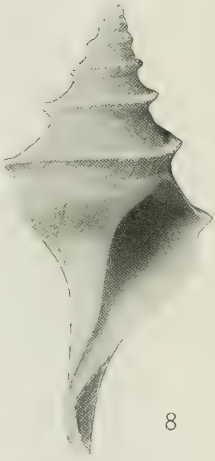

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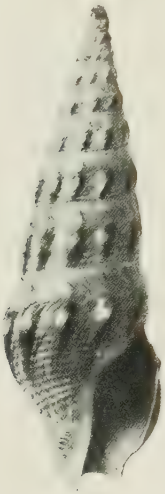
NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 82



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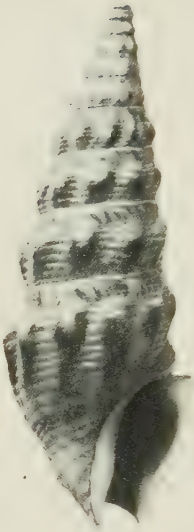

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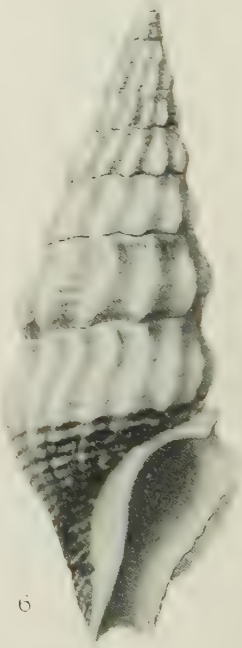

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 82

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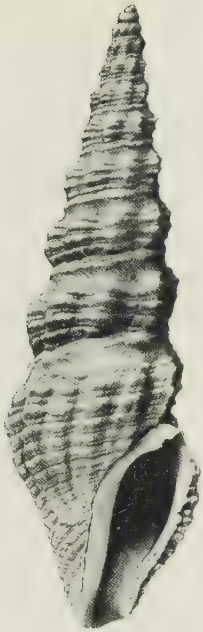

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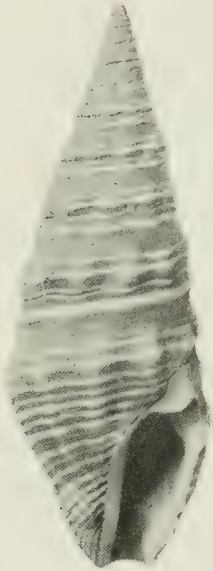
NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 83



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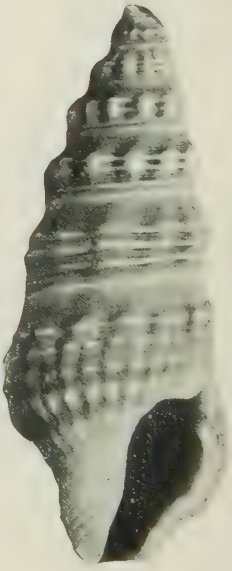

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 83

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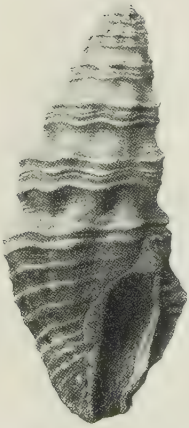

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 83

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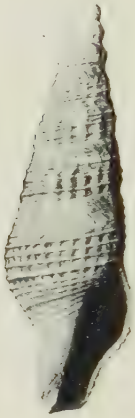

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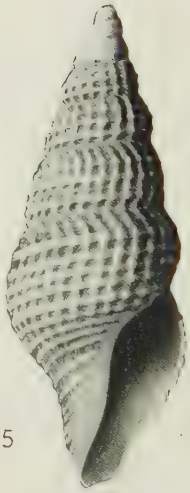

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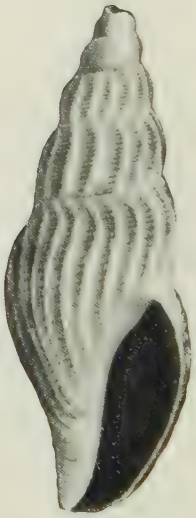

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 83

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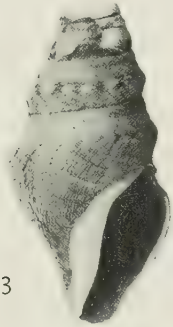

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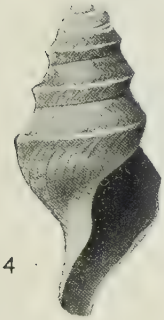

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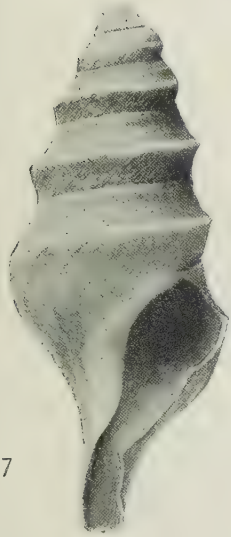

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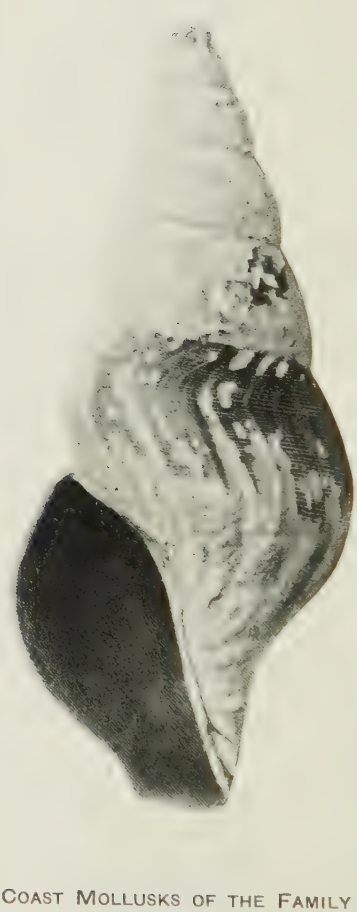
NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 83



NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 83

NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 84

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 84

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 84

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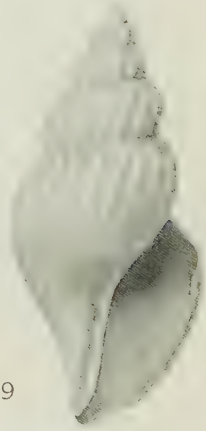

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 84

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 84.

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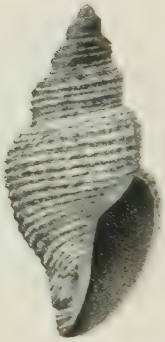

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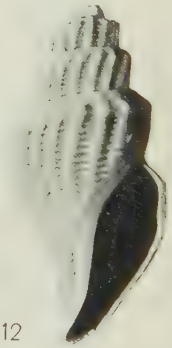

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGES 84 AND 85

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 85

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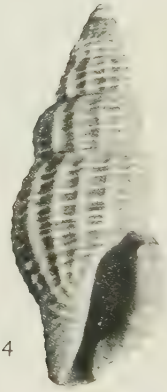

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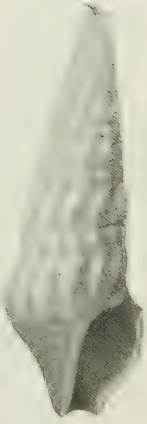

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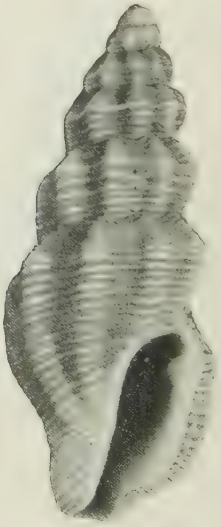

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 85

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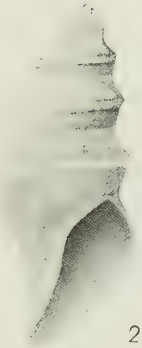

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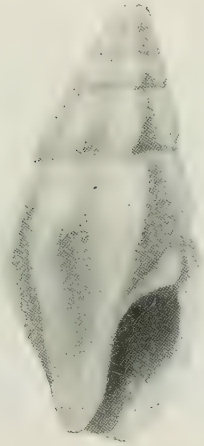

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 85

NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 85

NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 86

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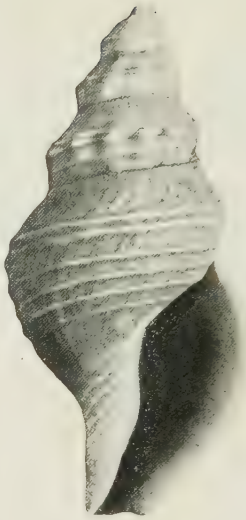

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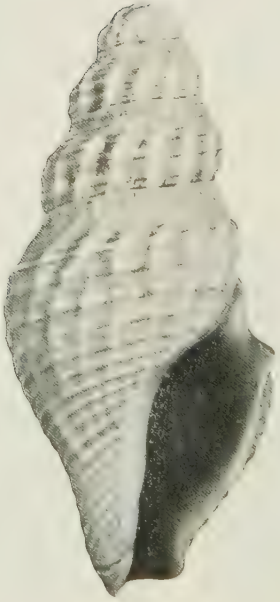

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NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 86

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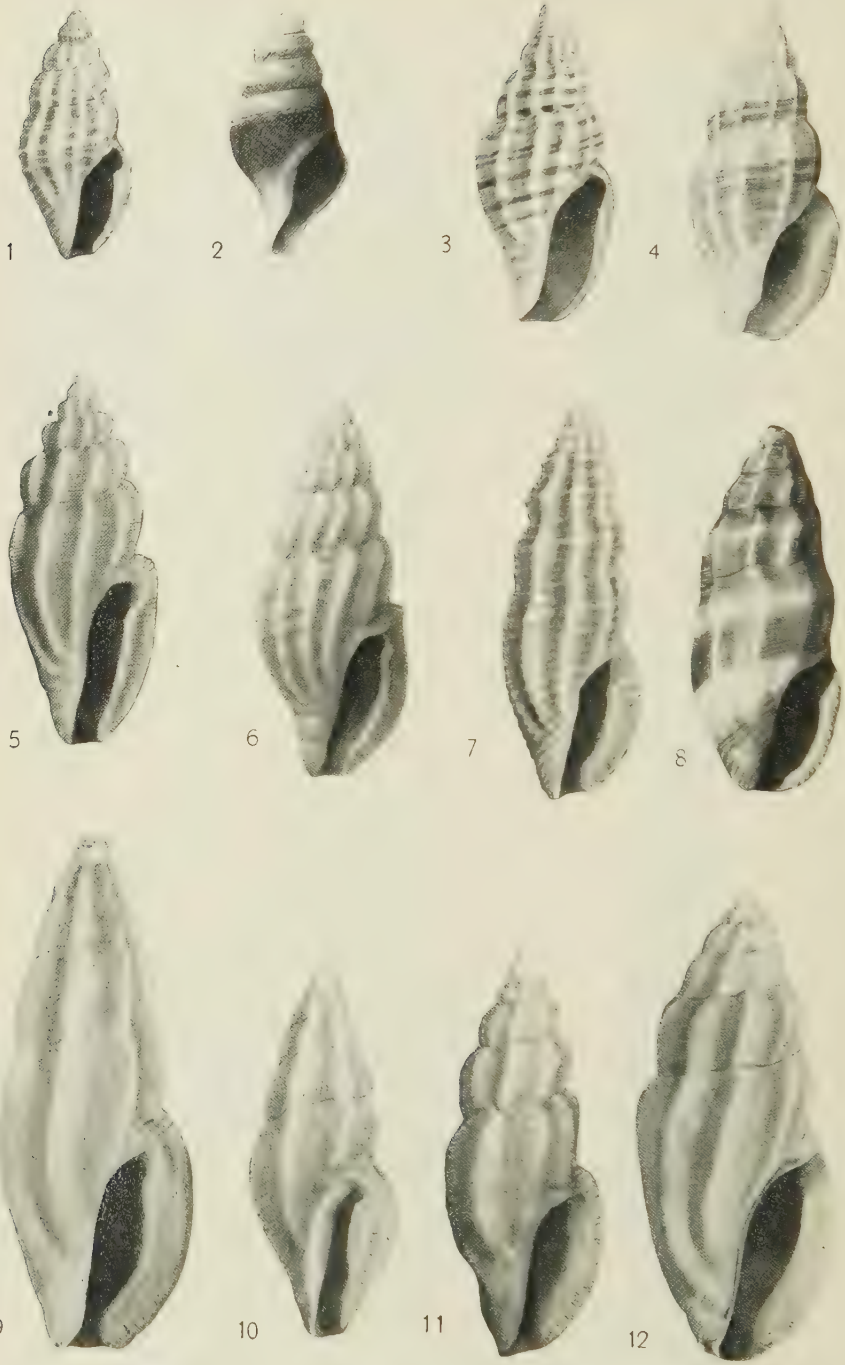
NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 86



NEW WEST COAST MOLLUSKS OF THE FAMILY TURRITIDAE

FOR EXPLANATION OF PLATE SEE PAGE 86

A REVIEW OF THE LEAFHOPPERS OF THE GENUS GYPONA NORTH OF MEXICO.

By Edmund H. Gibson,
Custodian of Hemiptera, United States National Museum.

The genus *Gypona* represents a group of leafhoppers that is more or less well known to all collectors of insects and especially to those who frequently have occasion to "sweep" or "beat" trees, bushes, cultivated plants and crops, and weeds. They often occur in considerable numbers in limited areas, assuming the proportions of a concentrated outbreak, and hence their economic importance is brought to attention.

The common large green species occur in most all collections of Homoptera, but in the majority of instances have been wrongly identified. The species are, however, quite easy to separate, and with the following key and short treatises upon the species the general entomologist should experience no difficulty in making correct determinations. It must, however, be said that the key is purely artificial and should be taken as a guide to, rather than positive means of, identification.

Eight species are herein described as new, making a total of 33 that are known to occur in North America north of Mexico. A much larger number of species are distributed throughout Central and South America. The genus is also represented in the Palaearctic, Ethiopian, Oriental, and Australian regions.

The genus was described by Germar in 1821. Since that time Stål in 1858 and J. Spånberg in his excellent treatises of the genus in 1878 and 1881 have added the most to our knowledge of the group.

The author has deemed it wise to omit a full description of each species, since the majority of species were described in available publications and in most cases in good detail. It is believed that a comparison of species will be of greater value, for identification purposes, than lengthy, minute descriptions which primarily "fill up space" and in this particular group of insects might tend towards confusion.

During the course of study of this group I have been greatly aided by the generous loan of specimens from Prof. Herbert Osborn, Messrs. H. G. Barber, W. L. McAtee, and Chris. E. Olsen. In the main, however, the paper is based upon specimens in the collection of the United States National Museum.

Genus GYPONA Germar.

Gypona GERMAR, Mag. d. Ent., vol. 4, p. 73, 1821.

KEY TO THE SPECIES.

1. Ocelli midway between median line of vertex and eyes....2.
   Ocelli nearer median line of vertex than eyes....17.
2. Base of clavus black or dark brown....3.
   Base of clavus not darkened....10.
3. Pronotum marked with one or two distinct spots near lateral borders....4.
   Pronotum unmarked laterally....6.
4. Elytra immaculate....27. *bipunctulata* Woodworth.
   Elytra with irregular, short, dark lines....5.
5. Species large. Elytra heavily marked. Pronotum spotted.30. *aquila*, new species.
   Species smaller. Elytra much lighter in color, pronotum light.
   26. *puncticollis* Spångberg.
6. Elytra with numerous irregular, short dark lines....28. *modesta* Spångberg.
   Elytra without such markings....7.
7. Species very small and decidedly green or yellowish, not brown.
   15. *occlusa*, new species.
   Species much larger and brownish in color....8.
8. Ocelli comparatively small, elytra without black dots, but with red flakes.
   22. *scarlatina* Fitch.
   Ocelli comparatively large, elytra with numerous small black dots....9.
9. Veins of elytra prominently bordered with black or dark brown dots. Species comparatively small....24. *curiata*, new species.
   Veins of elytra only very indistinctly bordered with slight punctations. Species comparatively large....20. *sanguinolenta* Spångberg.
10. A broad dark stripe running backward from the eye and just below lateral margins of pronotum....11.
    Without such a stripe....13.
11. Inner margin of elytra more or less darkened, elytra two shaded....12.
    Elytra of one shade, lighter colored, slightly smaller in size.13. *citrina* Spångberg.
12. Ocelli comparatively small. Species comparatively narrow.
    17. *limbatipennis* Spångberg.
    Ocelli comparatively large. Species comparatively broad.
    16. *pectoralis* Spångberg.
13. Species small. Female less than 10 mm. long....14.
    Species larger. Female more than 10 mm. long....15.
14. Last ventral segment of female regularly and deeply trisinuate. Species brown or reddish brown. Often flaked with red....21. *irrorella* Spångberg.
    Female segment not deeply trisinuate. Species green or yellowish, slightly golden, but not brown or reddish. Not flaked with red.
    14. *cacozela*, new species.
15. Female segment only feebly sinuate, if at all; slightly produced or trisinuate.
    12. *meditabunda* Spångberg.
    Female segment distinctly sinuate, slightly larger species....16.

16. Female segment with sinuations shallow.....23. *grisea* Spångberg.
Female segment with sinuations very deep.....7. *dictitoria*, new species.
17. Ocelli nearer anterior than posterior margin of vertex.....18.
Ocelli equidistant from anterior and posterior margins of vertex or nearer posterior.....19.
18. Margin of vertex bluntly rounded, species large.....29. *marginifrons* Fowler.
Margin of vertex thin, foliaceous, species small.....33. *dracontea*, new species.
19. Elytra reticulate.....20.
Elytra not reticulate.....24.
20. Anterior margin of vertex black. Two prominent black dots on pronotum.
5. *ramosa* Kirkaldy.
Anterior margin of vertex concolorous with rest of head. No black dots on pronotum.....21.
21. Female segment with a deep square notch at the middle of posterior margin.
1. *rugosa* Spångberg.
Female segment without a square notch at middle of posterior margin.....22.
22. Female segment trisinuate, middle one small, lateral ones larger.
3. *pruinosa* Spångberg.
Female segment simple, posterior margin concave.....23.
23. Female segment with a nearly truncate posterior margin, only slightly concave. Species small.....4. *geminata* Osborn.
Female segment with posterior margin noticeably concave. Species larger.
2. *octo-lineata* Say.
24. Vertex extremely long, nearly as long as pronotum.....25.
Vertex only a little over half the length of the pronotum.....27.
25. Species small, narrow, decidedly green. Vertex acutely pointed.
6. *tenella* Spångberg.
Species broader, brown or grayish. Vertex rounded, if pointed not acutely so..26.
26. Species small, short, less than 10 mm. long.....32. *cinerea* Uhler.
Species longer, larger, normally 10 mm. long.....31. *fraterna* Spångberg.
27. Species dark colored, head and pronotum black or partly so.....28.
Species greenish, yellowish, or brown, not black.....29.
28. Species stout, broad. Abdomen above solidly black....19. *melanota* Spångberg.
Species more slender. Abdomen above transversely banded with black.
18. *verticalis* Stål.
29. Base of clavus unmarked with black or dark brown.....30.
Base of clavus black or dark brown.....31.
30. Female segment nearly truncate, small tooth at middle.....11. *unicolor* Stål.
Female segment deeply and evenly sinuate as in *octo-lineata*.
8. *angulata* Spångberg.
31. Pronotum with a small black dot on either side. Female segment truncate or nearly so, without deep sinuations.....32.
Pronotum unmarked. Female segment with deep sinuations.
25. *negotiosa*, new species.
32. Species comparatively broad, large.....10. *bimaculata* Spångberg.
Species long and comparatively slender.....9. *nixabunda*, new species.

1. GYPONA RUGOSA Spångberg.

Gypona rugosa SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 6, 1878.

This species has the general appearance of *octo-lineata* Say, but from which it may easily be distinguished by the square deep notch in the last female segment. The roughened or rugose surface of the vertex, pronotum, and elytra is quite characteristic of this species.

Specimens have been examined from New York south to Florida and west to Colorado and Arizona.

2. GYPONA OCTO-LINEATA Say.

Tettigonia octo-lineata SAY, Compl. Writ., vol. 2, p. 257, 1824.
Gypona striata BURMEISTER, Gen. Ins., vol. 1, Rhynchota, No. 9, 1838.
Gypona cana BURMEISTER, Gen. Ins., vol. 1, Rhynchota, No. 10, 1838.
Gypona flavilineata FITCH, Homop. New York, State Cab., p. 57, 1851.
Gypona quebecensis PROVANCHER, Nat. Canada, vol. 4, p. 352, 1872.
Gypona flavilineata SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 8, 1878.
Gypona scrupulosa SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 9, 1878.
Gypona olivacea SPÅNGBERG, Ent. Tidskr. Stockholm, p. 24, 1881.
Gypona octo-lineata UHLER, Standard Natural History, vol. 2, p. 247, 1884.

This is the most common and widespread member of the genus in the United States. Great variation is exhibited in the general size and color of individuals and also in the reticulations of the elytra. The fact that the species has at various times been described under several different names is due to these mentioned variances. Biologic observations will prove the writer's opinion that the several so-called forms have no basis for specific value, and that the above names are correctly placed in synonomy. Spångberg laid too much stress upon the character of the reticulations of the elytra in separating and grouping species. While the majority of specimens of *octo-lineata* Say examined have reticulations on the clavus as well as corium, every gradation to the other extreme of no reticulations on any portion of the elytra have been seen. Again some specimens are brilliantly colored with red, while others are solidly green, and even some nearly white. However, the form and shape of the female genitalia is identical in each so-called form.

The species has been recorded from every section of the United States and from southern Canada.

3. GYPONA PRUINOSA Spångberg.

Gypona pruinosa SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 9, 1878.

This species resembles *octo-lineata* Say in general appearance. The female segment rather than being simply and deeply sinuate is distinctly and shallowly trisinuate. As far as available records show it is restricted to "east of the Rocky Mountains."

4. GYPONA GEMINATA Osborn.

Gypona geminata OSBORN, 20th Rept. State Ent., New York, p. 513, 1905.

The shorter vertex and nearly truncate female segment will serve to separate this species from *octo-lineata* Say, its nearest relative. It is somewhat smaller and lacks the amount of reticulations that is common to the majority of specimens of *octo-lineata* Say. The re-

ticulations of the wings of *geminata* Osborn are confined to the apical portion. It is a bright green species, becoming yellow in dried specimens.

The only two specimens that I have examined are paratypes from Professor Osborn's collection. They were captured from pine at Cold Springs Harbor, New York, 1904.

5. GYPONA RAMOSA Kirkaldy.

Gypona ramosa KIRKALDY, Hawaiian Sugar Planter's Assoc., Bull. No. 4, p. 60, 1907.

This southwestern species is conspicuous among other members of the genus because of its very thin or foliaceous anterior margin of the vertex, which is tinged with black. It is bright yellow or yellowish green, but sometimes nearly white. The elytra is heavily reticulate, having nearly a rugose appearance. There are two black dots near the anterior margin of the pronotum, one behind each eye. Specimens are entirely light beneath.

The only records of this species in the United States come from southeastern Arizona.

6. GYPONA TENELLA Spångberg.

Gypona tenella SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 34, 1878.

The long, produced, and rather acutely pointed vertex separates this from all the other green species. Otherwise in general appearance it resembles *angulata* Spångberg. It is one of the smallest members of the genus, the female measuring less than 8 mm. long.

The only specimens examined are from Texas, however it is also known to occur in Florida.

7. GYPONA DICTITORIA, new species.

Vertex short, less than one-half the length of pronotum; anterior margin comparatively thin and slightly produced at the middle. Vertex depressed behind apex. Ocelli very large and clear, placed midway between median line of vertex and eyes. A small dark spot behind each ocellus on posterior border of vertex. Pronotum not much wider than head, striations transverse. Elytra opaque with base of clavus unmarked, with appendix. Female segement produced at the middle with very deep sinuations on each side. Size, female 10.5–11 mm. long. Very robust.

Color, a decidedly green species, sometimes with inner margins of elytra mottled with brown, more often without any dark markings.

Type.—Female, Reddington, Arizona, collected by Dr. W. Barnes. (Collection of U. S. National Museum.) Cat. No. 21882.

Paratypes.—1 female and 1 male, Arizona. (Collection U. S. National Museum, P. R. Uhler.) 1 female, Huachuca Mountains, Arizona, collected by H. G. Barber. (Collection of H. G. Barber.) 1 female, Graham Mountains, Arizona, June 25, 1914, collected by E. G. Holt. (Collection of W. L. McAtee.)

8. GYPONA ANGULATA Spångberg.

Gypona angulata SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 32, 1878.

Gypona dorsalis SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 30, 1878. (?)

A western species which is quite distinct from all other members of the genus, although resembling *octo-lineata* Say in general appearance. However, the anterior margin of the vertex is much thicker and more broadly rounding than in *octo-lineata* Say and the elytra is never reticulate. The female segment is much the same in both species. It is a bright yellow to green species, sometimes nearly white. Dried specimens appear yellow.

Its distribution includes the Rocky Mountain States westward to the Pacific and north into Canada.

9. GYPONA NIXABUNDA, new species.

Vertex nearly one-half as long as width between the eyes, anterior margin thin, prominently depressed beneath. Striations on vertex oblique, transverse on pronotum. Ocelli comparatively small and nearer the median line of vertex than eyes and midway between anterior and posterior borders. A black spot on the pronotum behind each eye. Scutellum about equal to pronotum in length. Base of clavus black. Female segment with two small lobes at the middle and shallowly sinuate on either side. Size, female, 10 mm. long.

Color, female, entirely green or yellowish green, with only other color markings being the spots on pronotum and base of clavus darkened. Female same as male with dorsal side of abdomen more or less darkened in bands and apex of elytra smoky. Elytra transparent in both sexes in dried specimens. Veins of the hind wings of the male black.

Type.—Female, Denver, Colorado, August 13, 1915, collected by C. E. Jackson. (Collection of U. S. National Museum.) Cat. No. 21874.

Allotype.—Male, Huachuca Mountains, Arizona, collected by H. G. Barber. (Collection of H. G. Barber.)

Paratypes.—1 female, Williams, Arizona, and 1 male, Las Vegas, Hot Springs, New Mexico, collected by Messrs. Barber and Schwartz. (Collection of U. S. National Museum.)

10. GYPONA BIMACULATA Spångberg.

Gypona bimaculata SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 23, 1878.

This is a comparatively large and very broad green hopper, with a rather long vertex, with its anterior margin thin. There is a prominent black spot on the pronotum behind each eye. The elytra is transparent. With *unicolor* Stål they form a distinctive group within the genus. The comparisons of the two species will be noted under *unicolor* Stål.

Specimens have been examined and identified from New York, Pennsylvania, Maryland, Michigan, Iowa, Colorado, and New Mexico.

11. GYPONA UNICOLOR Stål.

Gypona unicolor STÅL, Stettin. Ent. Zeit., vol.25, p. 84, 1864.

This species closely resembles *bimaculata* Spångberg, but having a longer vertex, which is slightly more acutely pointed, and lacking the black spots on the pronotum. Also the base of the clavus is unmarked. The average of a long series of specimens will show it to be a somewhat narrower form than *bimaculata* Spångberg. The female segment is also more nearly truncate in *unicolor* Stål.

This is a western species and more especially southwestern.

12. GYPONA MEDITABUNDA Spångberg.

Gypona meditabunda SPÅNGBURG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 39, 1878.

This is an easily recognized species. In color it varies from a decided green to reddish brown. Normally the posterior two-thirds of the pronotum is rosaceous and often times the basal half of the elytra is so colored. The dorsal aspect is immaculate and shiny. The female segment is only slightly trisinuate. An eastern species extending as far west as the central Mississippi Valley.

13. GYPONA CITRINA Spångberg.

Gypona citrina SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 45, 1878.

Gypona pauperata SPÅNGBERG, Ent. Tidskr., p. 33, 1881.

This species greatly resembles *pectoralis* Spångberg. It is somewhat smaller, with less variation in color, the females being of one general color as viewed from above. Elytra entirely opaque. A lighter species. The spots on the elytra of the females are indistinct, but very prominent on the males. The wings are less smoky than in *pectoralis* Spångberg.

This is strictly a southern species. Specimens in the collection of the United States National Museum are from Florida and Texas.

14. GYPONA CACOZELA, new species.

The vertex of this species is not produced, but is nearly as long as one-half the length of the pronotum, with anterior margin thick and broadly rounding. Ocelli comparatively large and situated midway between median line of vertex and eyes and somewhat nearer the anterior than posterior border. Striations of pronotum prominent. Elytra with base of clavus darkened and with four small black spots more or less prominent. Elytra opaque, inner margin beyond clavus clouded with brown. Hind wings light colored but opaque. Female segment produced at the middle and with a small notch. Size, female, 9 mm. long.

Color, yellow or yellowish brown or orange, much the same as *citrina* Spångberg. Vertex and scutellum distinctly yellow to yellowish green. Pronotum, especially posterior half, orange or light brown. Entirely light beneath.

Type.—Female, *allotype*, male, *paratypes*, 2 females, Los Borregos, Brownsville, Texas, collected by H. S. Barber. (Collection of U. S. National Museum); 2 males, Brownsville, Texas, collected by C. H. T. Townsend. (Collection of U. S. National Museum). Cat. No. 21883.

This species closely resembles *citrina* Spångberg.

15. GYPONA OCCLUSA, new species.

The vertex is broadly rounding, not produced, about one-half the length of pronotum and nearly as broad. Ocelli comparatively large and situated midway between the median line of the vertex and the eyes. Pronotum prominently striated and marked with a small black spot near anterior border behind each ocellus. Elytra with base of clavus darkened and with a broad appendix. Female segment slightly produced at the middle and prominently sinuate on each side. Size, female, 7 mm. long. About the smallest species in the United States. Comparatively narrow for its length.

Color, yellow and orange when dried, much the same general appearance as *citrina* Spångberg in color. Probably yellowish green when alive. Elytra shiny and not as opaque as in *citrina* Spångberg or *cacozela* Gibson.

Type.—Female, *allotype*, male, and one paratype male, from Los Borregos, Brownsville, Texas, collected by H. S. Barber. (Collection of U. S. National Museum.) Cat. No. 21884.

16. GYPONA PECTORALIS Spångberg.

Gypona pectoralis Spånberg, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 46, 1878.

Gypona albimarginata Woodworth, Illinois. Lab. Nat. Hist., vol. 3, p. 31, 1896.

Gypona hullensis Provancher, Les Hem., 1889.

Gypona woodworthi VAN DUZEE, Canadian Ent., vol. 46, No. 2, p. 389, 1914.
Gypona bimaculata WOODWORTH, Illinois Lab. Nat. Hist., vol. 3, p. 32, 1896.

The identity of this species in the past has been much confused, owing probably to its variation in size and color. It has the general form and shape of *meditabunda* Spångberg, but is somewhat smaller and has a distinct coloration. The wings are smoky and dark, which show through the semitransparent inner border of the elytra, making a contrast to the costal border, which is bright yellow, orange, or rosaceous. There are four small black spots on the elytra which are always more or less distinct.

The species is rather common throughout the eastern half of the United States. Records are at hand showing its occurrence from Minnesota and Nebraska southward to the Gulf and eastward to the Atlantic.

17. GYPCNA LIMBATIPENNIS Spångberg.

Gypona limbatipennis SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 47, 1878.

This species belongs to the *pectoralis* Spångberg group, but differing from that species in the more reflexed anterior margin of the vertex, comparatively smaller ocelli, and darker coloration of the elytra. The specimens examined are comparatively narrow for their length. The costal border of elytra is yellowish, the remainder being dark brown to nearly black. The vertex is considerably depressed behind the anterior margin giving the margin the appearance of being reflexed.

The only records of its occurrence are from Illinois and New York. It is a rather rare species. Fitch gave the manuscript name of *fraxini* for this species.

18. GYPONA VERTICALIS Stål.

Gypona verticalis STÅL, Stettin. Ent. Zeit., vol. 25, p. 84, 1864.
Gypona mexicana SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 18, 1878.

This species is similar to *melanota* Spångberg in general color. Comparatively more narrow and a smaller species. The elytra are smoky and dark, but have a light spot on costal margin near apex.

The specimens I have examined were all from New Mexico. It is known to occur in Mexico and Central America.

19. GYPONA MELANOTA Spångberg.

Gypona melanota SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 19, 1878.
Gypona nigra WOODWORTH, Illinois Lab. Nat. Hist., vol. 3, p. 31, 1896.

This is one of the darkest colored species in the genus. Specimens as viewed from above often appear jet black. The vertex, pronotum except lateral borders, and scutellum are normally black but often

times are faded to a yellow. The elytra are entirely smoky and usually dark.

It is an eastern species and occurs as far west as Colorado.

20. GYPONA SANGUINOLENTA Spångberg.

Gypona sanguinolenta SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 63, 1878.

This is the darkest colored of the species that form the *sanguinolenta* Spångberg, *scarlatina* Fitch, *irrorella* Spångberg, *grisea* Spångberg group. The four small dark spots on the elytra are always distinct. The cells of the elytra are interspersed with black dots, and there are normally two dark spots on the pronotum behind the ocelli. The ocelli are comparatively large. The head and vertex may be flaked with red.

Specimens are at hand from Massachusetts to Florida and west to the Mississippi Valley.

21. GYPONA IRRORELLA Spångberg.

Gypona irrorella SPÅNBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 60, 1878.

This species has a striking resemblance to *scarlatina* Fitch, but may be distinguished from it by the fact that the base of the clavus is not darkened, also the vertex is less produced in *irrorella* Spångberg. The species must also be considered closely allied to *grisea* Spångberg, from which it differs in being much smaller and having comparatively smaller ocelli. *Irrorella* Spångberg is normally flaked with red as in *scarlatina* Fitch and *sanguinolenta* Spångberg, but is lighter in general appearance.

It is primarily a southern species, but is known to occur throughout the Central States. It appears to be less common than any of the above-mentioned species.

22. GYPONA SCARLATINA Fitch.

Gypona scarlatina FITCH, Homop. New York State Cab., p. 57, 1851.

The comparatively small ocelli, and somewhat produced vertex will distinguish this from other closely related species. The vertex, pronotum, and elytra may be flaked with red but the elytra lack the black dots as in *sanguinolenta* Spångberg. Fresh specimens are of a decided brown color with the head appearing somewhat rosaceous or light reddish brown.

It is a northern species and must be kept as a distinct species until large numbers can be examined when it may prove to be merely a northern form of *sanguinolenta* Spångberg. Fitch's type has been examined.

23. GYPONA GRISEA Spångberg.

Gypona grisea SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 64, 1878.

The identity of this species should not be at all confused, being very distinct from all other species. It is one of the largest species in the genus, measuring about 12 mm. long and is comparatively broad. The two dried specimens examined would indicate that live individuals have a decided brown appearance. The entire dorsal surface is finely flaked with red. The vertex is broadly rounding and but little produced. Veins of the elytra are margined with minute punctures.

The only available records of capture are from Georgia and North Carolina.

24. GYPONA CURIATA, new species.

The vertex is short, only slightly produced, anterior margin rather thick and rounding, striations transverse. Ocelli comparatively large and placed midway between median line of vertex and eyes. Pronotum not quite three times as long as vertex, with transverse striations and numerous minute dark colored punctures on posterior two-thirds. Scutellum with striations but lacking punctations. Elytra semi-transparent, with base of clavus black, veins sometimes with faint irregular markings in cells, veins prominently bordered with minute punctations. Female segment, nearly truncate, only shallowly sinuate if at all. Size, female, 8.5 mm. long.

Color, dried specimens are a light brown, live specimens would probably be yellowish brown, certainly a brownish species.

Type.—Female, *allotype*, male, Arizona. (Collection of U. S. National Museum, P. R. Uhler.) Cat. No. 21885.

Paratypes.—1 female, same as type. 2 males, Arizona, collected by Morrison. (Collection of U. S. National Museum.) 5 females and a male, Huachuca Mountains, Arizona, collected by H. G. Barber. (Collection of H. G. Barber.)

25. GYPONA NEGOTIOSA, new species.

The vertex of this species is nearly one-half as long as width between the eyes, anterior margin thin, prominently depressed beneath margin and also behind margin on vertex. Vertex somewhat produced and angulate. Ocelli comparatively small and nearer the median line of vertex than eyes and midway between anterior and posterior borders. A black spot on posterior border of vertex just outside each ocellus. Four dark spots on anterior border of pronotum, one behind each spot of vertex and one in each anterior lateral angle. Base of clavus darkened. Female segment bisinuate with a small notch at middle of central lobe. Elytra with the four prominent spots as in *pectoralis* Spångberg and also with numerous smaller

spots in each cell of the elytra. Size, female, 9 mm. long; male shorter.

Color, the dried specimens from which the description is made are yellowish and grayish brown, indicating that in live specimens the prevailing color would be brown. The males are darker, being more heavily dotted with black punctations along veins of elytra, and also on vertex and pronotum.

The species more nearly resembles *sanguinolenta* Spångberg than any other member of the genus although it is distinctly different even from it.

Type.—Female, Hillsborough County, Florida. (Collection of U. S. National Museum.) Cat. No. 21886.

Allotype.—Male, Raleigh, North Carolina. Collected by Z. P. Metcalf, July, 1909. (Collection of U. S. National Museum.)

Paratypes.—1 female, Plummer's Island, Maryland. Collected by H. S. Barber. (Collection of Herbert Osborn.) One male, Glencarlyn to mouth Four Mile Run, Virginia, June 17, 1914. Collected by W. L. McAtee. (Collection of W. L. McAtee.) One male, Raleigh, North Carolina, June, 1909, collected by Z. P. Metcalf. (Collection of U. S. National Museum.)

26. GYPONA PUNCTICOLLIS Spångberg.

Gypona puncticollis SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 54, 1878.

Gypona quadri-notata SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 56, 1878.

Gypona albosignata UHLER, Colorado Exp. Sta., Bull. No. 31, 1895.

The characters as given in the key are sufficient to readily distinguish this species. It somewhat resembles *modesta* Spångberg but is much more slender or narrow in form and with not so many darkened veins or irregular dark lines on the elytra. The vertex is short and broadly rounding. The four small black spots along the anterior margin of the pronotum and the blackened apex of the clavus are also characteristic for identification.

A cotype of Uhler's *albosignata* is in the collection of the United States National Museum.

The species is known to occur from Massachusetts westward to Kansas and south into Central America and the West Indies.

27. GYPONA BIPUNCTULATA Woodworth.

Gypona bipunctulata WOODWORTH, Illinois Lab. Nat. Hist. Bull., No. 3, p. 30, 1887.

This species resembles *marginifrons* Fowler in the short and has a broadly rounding anterior margin of the vertex. The ocelli are comparatively large and placed as in *marginifrons*. *Bipunctulata* Woodworth is, however, somewhat smaller and lacks the distinctive dark bordering of the veins of the elytra and the irregular dark markings on the anterior border of the pronotum. There are two

dark spots near the anterio-lateral angles of the pronotum which may be considered diagnostic characters.

Uhler's manuscript name *intertexta* applies to this species.

Normally it appears to be a southeastern species; however, it has been recorded from other parts of the country east of the Rocky Mountains.

28. GYPONA MODESTA Spångberg.

Gypona modesta SPÅNGBERG, Ent. Tidskr., vol. 4, p. 107, 1883.

The prominent dark veins of the elytra, with numerous dark irregular lines, together with the more or less pointed vertex, serve as distinguishing characters for this species. It is a relatively large and decidedly brown species, however; in dried specimens the elytra sometimes fade to a dirty yellow. The female segment is nearly truncate, being slightly produced at the middle. Fitch has given the manuscript name of *columba* for this species.

Records indicate the distribution of the species to be from Massachusetts west to the Rocky Mountains.

29. GYPONA MARGINIFRONS Fowler.

Gypona marginifrons FOWLER, Biol. Cent. Amer., p. 302, 1909.

This is the most easily recognized of all species. The short, broadly rounding vertex, with ocelli placed nearer the anterior than posterior border, constitute the most prominent characteristics. The anterior margin of the pronotum is marked with irregular dark lines. It is a rather large brownish species. Veins of elytra distinctly dark brown.

Specimens at hand are from Arizona and New Mexico.

30. GYPONA AQUILA, new species.

The vertex is short, not produced, broadly rounded, anterior margin thick. Minute transverse striations on vertex. Ocelli comparatively large and placed equidistant from median line and eyes, and slightly nearer the anterior margin of vertex. Median line darkened. Two dark spots on posterior border of vertex behind eyes. Width of pronotum much greater than width of head and more than three times as long. Several small dark spots and one or two irregular lines near anterior border of pronotum. Transverse striations and numerous tiny dark punctations prominent. Scutellum large. Elytra with base of clavus black and with veins lined with minute punctations. Elytra semitransparent, with numerous irregular dark lines in cells. A prominent small, white, opaque, longitudinal area along middle of the inner margin of clavus. Female segment produced at the middle with a small notch and sinuate on each side. Size, female, 10.5 mm. long.

Color, general appearance dark grayish brown, due to the many dark markings on pronotum and elytra. Ground color of head, pronotum, and scutellum yellow in dried specimens. Hind wings dark and smoky. Entirely light beneath.

Type.—Female; *allotype*, male; *paratypes*, 2 females; all from Huachuca Mountains, Arizona, collected by H. G. Barber. (Allotype in collection of H. G. Barber.) Cat. No. 21917. (Type and paratypes in collection U. S. National Museum.)

This species is very distinct from all others of the genus, but most nearly resembles *modesta* Spångberg.

31. GYPONA FRATERNA Spångberg.

Gypona fraterna SPÅNGBERG, K. Svenska Vet. Akad. Handl., vol. 5, No. 3, p. 72, 1878.

This species, with *cinerea* Uhler, are characterized by the extremely long vertex, which nearly equals the length of the pronotum. Viewed from above they have the general appearance of the Cercopid genus *Philaenus*.

Fraterna Spångberg is the more common of the two species occurring throughout the entire United States, while *cinerea* Uhler is most abundant in the extreme Southwest. *Fraterna* Spångberg is comparatively large and varies in color from light yellowish gray to dark brown.

32. GYPONA CINEREA Uhler.

Gypona cinerea UHLER, Bull. U. S. Geol. Surv., vol. 3, p. 460, 1877.

Besides the comparisons as noted under *fraterna* Spångberg, it may be said that the abdomen of *cinerea* Uhler is usually darker and the male plates are comparatively narrower. The female segment is deeply bisinuate.

33. GYPONA DRACONTEA, new species.

The vertex is about one-half as long as pronotum and generally concave, not produced, anterior margin thin. Ocelli comparatively small and placed midway between median line of vertex and eyes. Pronotum not much wider than head. Elytra reticulate toward apex, apical area rugose or wavy. Female segment notched at the middle with a blunt tooth. Size, females 6.5 mm. long. Short and robust, having the general appearance of an *Xerophloea*.

Color, the upper surface finely punctate with red. Ground color yellowish. The red punctures sometimes become brown. Elytra tinged with red and mottled more or less with brown. Veins of the elytra spotted. Elytra opaque to apical area, which is transparent. A light spot at center of claval suture.

Type.—Female; *allotype*, male; *paratype*, 1 female; Huachuca Mountains, Arizona. (Collection of U. S. National Museum.) Cat. No. 21887.

Paratype.—1 female, Nogales, Arizona, Koebele. (Collection of Herbert Osborn.)

The most highly colored and distinctive species in the genus occurring in the United States.

A NEW FORAMINIFER COMMENSAL ON CYCLAMMINA.

By Joseph A. Cushman,
Of the Boston Society of Natural History.

Specimens of *Cyclammina* are occasionally found which, instead of being bilaterally symmetrical, have the last few chambers much extended on one side. Such specimens have a deep depression in the umbilical region of the same side. These have been noted in the material collected by the United States Bureau of Fisheries steamer *Albatross* from the northeastern coast of the United States in my examination of that material, but without a discovery of the cause. On examining material from *Albatross* station D2213 a number of specimens of *Cyclammina* with this character were noted, and a further search revealed the cause for the abnormal form.

It is caused by the attachment of a single-chambered species of foraminifera to the outside of the test of the specimen of *Cyclammina* and the further growth of the test about this. When the attached form falls away it leaves the resulting space unoccupied and the resulting depression. So far as the material shows this seems to be a one-chambered species with a chitinous wall somewhat arenaceous in parts but with little variation in size.

The position as shown in plate 25, figure 4, is at the edge of the aperture when the attachment is made. Later, by the continued growth of *Cyclammina* this position becomes more nearly umbilical. There is as a rule but a single attached specimen, but two may be attached, either on one side as shown in plate 25, figure 1, or there may be one on each side, as in figure 3. This at once suggests that little or nothing is known of the life habits of *Cyclammina* except that it is a heavy, bottom-living form. If the attached specimens were always on one side only it would suggest that *Cyclammina* might live on its side, but with specimens with both sides occupied this does not hold. *Cyclammina* might lie with its appertural face uppermost which would allow opportunity for the pseudopodia both of the attached form and of itself to rise easily to the surface of the bottom ooze. At any rate, *Cyclammina* seems too heavy to be a form with any great freedom of movement.

The position of the attached form near the aperture suggests a commensal condition. There is no fusion between the two, for the attached form falls away, leaving a clean-cut surface.

The degree of deviation from a symmetrical condition depends on the length of time of attachment. In figure 4 the attached specimen is on a large *Cyclammina* which has reached nearly its full development and the deviation is very slight. In smaller specimens like figure 2, where several chambers have been added since the attached species was in position, there is a marked deviation. In figure 3, where specimens are attached to both sides, a sort of symmetry results as both sides deviate from their normal line.

IRIDIA CONVEXA, new species.

Plate 25, figs. 1–4.

Description.—Test attached, single chambered, lower surface conforming to the surface of attachment, upper surface strongly convex, whole test slightly longer than wide; wall thin, chitinous, with a slight amount of arenaceous material either on the exterior or incorporated in the wall; aperture not evident; color yellowish-brown, horny. Diameter, 0.50 to 0.65 mm.

Type-specimen.—(U.S.N.M. Cat. No. 10441*a*) from *Albatross* D2213, off the northeastern coast of the United States; latitude 39° 58′ 30″ N.; longitude 70° 30′ W.; depth, 384 fathoms; bottom temperature, 39.5° F. At this station there are numerous specimens, all attached to specimens of *Cyclammina cancellata* H. B. Brady.

I have placed this species under the genus *Iridia* erected by Heron-Allen and Earland, although this species differs in some respects from the type-species *I. diaphana* Heron-Allen and Earland.

It is unusual among the foraminifera to find attached forms with any definite relation of position as seems to occur in the case of these two species, and although the idea of commensalism may not be demonstrated here it is at least strongly suggested.

EXPLANATION OF PLATE 25.

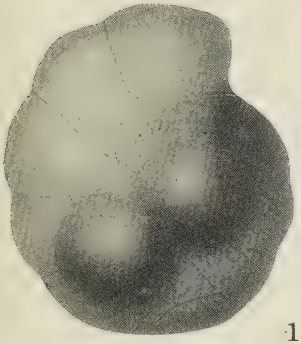
FIG. 1. *Cyclammina cancellata*, with two specimens of *Iridia convexa* attached to the same side. *a*, side view; *b*, apertural view.

2. *Cyclammina cancellata*, with deep excavation in the umbilical region due to attachment of *Iridia convexa*. *a*, side view, *b*, apertural view.

3. *Cyclammina cancellata*, with specimens of *Iridia convexa* attached to the opposite sides.

4. Adult specimens of *Cyclammina cancellata*, with specimen of *Iridia convexa* attached near the aperture. *a*, side view; *b*, apertural view.

All figures multiplied by 25.



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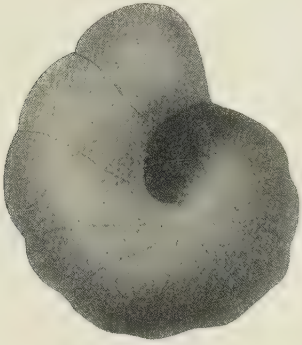

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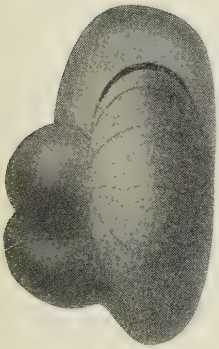

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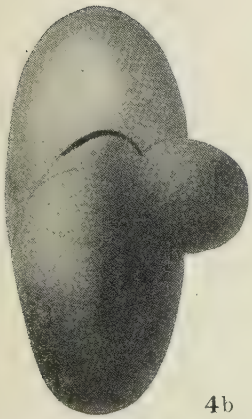
3

2b



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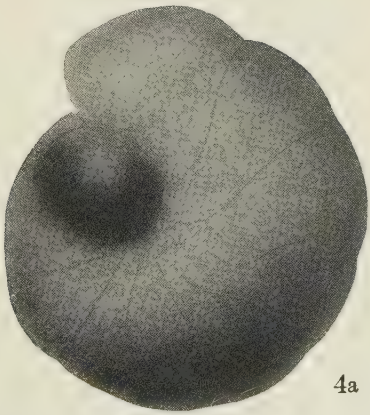


4a

A NEW FORAMINIFER COMMENSAL ON CYCLAMMINA

FOR EXPLANATION OF PLATE SEE PAGE 102

DESCRIPTIONS OF SOME MAMMALIAN AND FISH REMAINS FROM FLORIDA OF PROBABLY PLEISTOCENE AGE.

OLIVER P. HAY.
Associate of the Carnegie Institution of Washington.

There are few of our States which give promise of furnishing more important contributions to our knowledge of the vertebrate animals of the Pleistocene than Florida. Already the list of species has become a long one and additions are constantly being made to it. Materials belonging to five species are described below. Two of these are believed to be hitherto unnamed.

ELEPHAS IMPERATOR Leidy.

Plate 26, fig. 1.

In 1889[1] Leidy described and figured a left ramus of the lower jaw of an elephant which had been found by Mr. J. F. LeBaron, somewhere along Peace Creek, probably not far from Arcadia, and which Leidy identified as belonging to *Elephas columbi*. Leidy's figure presents a view of the worn surface of the tooth, which he recognized as being the hindermost molar. He stated that there were twelve ridges present and that these appeared to be the complete number entering into the constitution of the tooth. Eight of these were said to occupy a space of 6.4 inches. Inasmuch as the tooth was buried in the bone nearly to its summit, the thickness of the plates was taken on the grinding surface.

This jaw is in the United States National Museum, and has the catalogue number 183. Recently the writer obtained permission to expose the lingual face of the tooth, and the result is shown on plate 26 (fig. 1). Near their bases the space occupied by four plates is about 95 mm. There can be no doubt that the jaw belonged to an individual of *Elephas imperator*. The normal number of plates in the last tooth of *E. columbi* is about 24. Had there ever been so many plates present the tooth would have had an enormous length. With 18 plates it was sufficiently large. Certainly some plates, about six, had been lost through usage.

[1] Trans. Wagner Free Inst. Sci., vol. 2, p. 23, pl. 8, fig. 2.

THINOBADISTES, new genus.

A new genus of ground sloths, most closely related to *Gnathopsis* Leidy Type, *T. segnis*, a new species described below. Based on an astragalus, in the front half of the upper surface of which there is a deep ligamentous fossa opening forward; the lower face also crossed from front to rear by a ligamentous fossa.

THINOBADISTES SEGNIS, new species.

Plate 27, figs. 1, 2.

Type specimen. An astragalus, No. 3335, of the U. S. National Museum.

Type locality.—Williston, Florida.

Type formation.—Pleistocene.

Characters.—Those of the genus.

In the United States National Museum there is a left astragalus of a large ground sloth which is recorded as having been collected by the United States Geological Survey in 1887, in Levy county, Florida. The catalogue number is 3335, and the bone is recorded a *Mylodon harlani*. It seems probable that the collector of the specimen was Mr. J. B. Hatcher; and it is quite certain that it was found at "Mixon's bone bed," near Williston, where many other fossils have been secured.

It appears that this bone had been studied by Doctor Leidy, for there is writing on it in his chirography; but he has not indicated on it any generic or specific name.

Supposing that the bone belonged to *Mylodon harlani*, the astragalus of which appears to be known only from Harlan's brief description and poor figure,[1] the writer first compared it with that of *Mylodon robustus*, as described and figured by Richard Owen.[2] It soon became evident that the Florida bone was quite different from the corresponding one of the South American species. On plate 27, figures 1, 2, are presented two views of the bone from Florida. From figure 1 it will be seen that there is on the upper face a deep fossa extending from the front of the bone to its center. A large part of this fossa is occupied by a rough surface for ligamentous attachment, the apex of which is midway between the front end of the bone and the hinder border of the articulation for the tibia. In all directions away from the fossa just mentioned the surface for articulation with the tibia is strongly convex. In *Mylodon robustus* the corresponding fossa is evidently much shorter and shallower, and the surface for the tibia is much flatter and apparently even concave posteriorly. The greatest differences are seen, however, on the lower surface of

[1] Amer. Journ. Sci., vol. 44, 1843, p. 78, pl. 1, fig. 16.

[2] Descr. skel. *Mylodon robustus*, 1842, pp. 117, 131, pls. 21–23.

the bone. Owen writes[1] that the anterior and inferior surface of the astragalus of *Mylodon robustus* is occupied by one extensive elongated articular surface adapted to the calcaneum, cuboides, and naviculare, and his figure shows that this is true. On the other hand, in the bone from Florida, this surface is completely divided by a deep rough furrow for ligaments. It will be noted, too, that the outlines of the two bones as seen from below are very different.

It might be supposed that the astragalus here described is that of *Megalonyx;* but this bone was described by Leidy,[2] and only a glance at Leidy's figures is needed to convince one that the Florida bone can not belong to that genus.

Owen[3] described and figured an astragalus which had been brought from South America and which he thought belonged possibly to *Megalonyx.* This was afterwards made by Leidy[4] the type of a new genus and species, *Gnathopsis oweni.* When the Florida bone is compared with Owen's figures here reproduced (pl. 27, figs. 3, 4) there are to be seen close resemblances. It might not be far out of the way to refer the astragalus from Florida to a second species of *Gnathopsis,* but a careful examination shows differences that seem to indicate a distinct but closely related genus. On the upper surface of the bone figured by Owen there was certainly no such deep fossa for a process of the tibia and for a ligament as is seen in the Florida bone. Nor was the surface for the tibia as convex as it was in the bone here described. Again, as seen from below, there was in the astragalus of *Gnathopsis* a deep and wide notch in the anterior border at the end of the ligamentous groove, as if this and the upper one joined across the border of the bone. In the Florida bone the anterior surface for articulation with the calcaneum extends nearly to the inner border of the bone; in *Gnathopsis oweni* it is much shorter. Believing that such differences in as characteristic a bone as the astragalus is among the ground sloths, indicate other important differences in the skeleton, the name *Thinobadistes* is proposed for the genus, the species to be known as *Thinobadistes segnis.* (Derivations, *θις* sand; *βαδιστής,* a walker; *segnis* sluggish.)

The following measurements in millimeters have been made on the astragalus here described:

Extreme length of astragalus	108
Width from summit of tuberosity for tibia to border between the fibular and the calcaneal surfaces	97
Length of surface for tibia	76
Width of surface for tibia	70
Height and length of surface for fibula	38
Length of posterior articular surface for calcaneum	69
Width of posterior articular surface for calcaneum	38

[1] Descr. skel. *Mylodon robustus,* p. 118.
[2] Smiths. Contrib. Knowl., vol. 7, art. 5, p. 40, pl. 12, figs. 7–10.
[3] Descr. skel. *Mylodon robustus,* p. 132, pl. 23, figs. 3, 4.
[4] Smiths. Contrib. Knowl., vol. 7, p. 41.

The posterior surface for the calcaneum is concave along its greater diameter; slightly convex along the shorter. The surface for the fibula is nearly plane in its upper part, but convex from front to rear in its lower half. The articular surface for the navicular is concave, but not deeply so. The surface for the cuboid is convex.

TRUCIFELIS FLORIDANUS (Leidy).

Plate 28, figs. 1–3.

In 1889[1] Leidy described a skull of a saber-tooth tiger to which he gave the name *Machairodus floridanus*. This had been secured by Mr. Joseph Willcox, in a limestone quarry at Ocala, Florida. From the same quarry had been obtained other remains which are referred to *Equus leidyi*, *Bison*, sp. indet., *Odocoileus* sp. indet., *Dasypus* sp. indet., *Sylvilagus* sp. indet., *Procamelus minor*, and *Elephas columbi*.[2] All of these indicate that the deposits belong to the Pleistocene.

From the skull described by Leidy all the teeth were missing; but there were present the alveoli for the upper incisors, the great canine, the third premolar, and the carnassial. This skull was figured in a later paper.[3]

In the Eighth Annual Report of the Florida Geological Survey, on plate 29, figure 8, Dr. E. H. Sellards figured an upper carnassial premolar which had been found at Vero, Florida, in the stratum known in the literature of that locality as No. 2. This he referred (p. 152) to *Smilodon*. Recently, through the kindness of Doctor Sellards, the writer has been permitted to examine the tooth in question. By comparing the figure of this tooth here presented (pl. 28, figs. 1, 2) with that of Leidy's *Trucifelis fatalis*[4] it will be seen that there is between them a close resemblance. It will be necessary first of all to determine whether or not the Vero tooth belongs to *T. fatalis*. The following measurements enable us to make comparisons, those of *T. fatalis* being computed from Leidy's description[5]. In the second column under each tooth is given the ratio of each dimension to the length of the tooth.

Dimensions of upper carnassials.

	Trucifelis fatalis type.		Vero tooth.	
	1	2	1	2
Length of crown	32.8	100	40	100
Width at inner buttress	15.6	41	17	42.5
Height of principal cusp	18.7	57	26	65
Height of anterior lobe	14.6	44.5	19	47.5
Height of front of rear lobe	13.5	41	19	47.5

[1] Proc. Acad. Nat. Sci. Phila., p. 29.
[2] Sellards, 8th Ann. Rep. Fla. Geol. Surv., p. 103.
[3] Trans. Wagner Free Inst. Sci., vol. 2, pl. 3, fig. 1.
[4] Ext. Mamm. Fauna Dak., Neb., pl. 28, figs. 10, 11.
[5] Idem, p. 367.

It will be seen at once that the Vero tooth was probably that of a larger species than *T. fatalis* and that the crown is everywhere higher in proportion to its length. As may be seen from comparing the figures of the two teeth, the width of the principal cusp at its base is one-half of its height, while that of *T. fatalis* is relatively considerably wider. The two teeth agree in having the protocone absent and in having the anterior lobe divided into two parts. It appears certain that the Vero tooth does not belong to *T. fatalis*. The latter was found at Sour Lake, in Hardin County, Texas.

Through the courtesy of Mr. John G. Rothermel, director of the Wagner Free Institute, the writer has been able to examine the upper jaw of Leidy's type of *Machairodus floridanus*. The carnassial possessed in front two roots, of which the inner was somewhat reduced in size and pushed backward, as in the Vero tooth, to nearly opposite the interval between the anterior outer root and the great hinder root. It is quite certain that the anterior lobe of the tooth was much larger than it is in the lion and the tiger. The alveolus has a length of 37 mm.; that part for the hinder root is 24 mm. long. The tooth was therefore only slightly larger than the Vero tooth; and there appears to be no reason why the latter can not be with much certainty referred to Leidy's species.

In the deposit at Vero which furnished the carnassial Doctor Sellards found a part of a great canine tooth which belonged to some one of the Machairodontinae. The fragment (pl. 28, fig. 3) is 67 mm. long. Probably nearly 25 mm. of the distal extemity is gone. The upper end does not reach the base of the crown. In the Ocala skull the socket for the canine measures 40 mm. in length fore and aft and its width is 20 mm. At its upper end the fragment from Vero has a width for and aft of 30 mm. and a thickness of 13 mm. If the front and rear borders of this tooth are continued until the distance between them is 40 mm. and the distal extemity is restored, a tooth is indicated whose crown was about 110 mm. long. Both borders are acute, more especially the hinder one, which is knife-like. The anterior edge is smooth, but the hinder one is obsoletely crenulated. The tooth is quite different from that of Barnum Brown's *Smilodontopsis conardi*.[1] In the latter the base of the fragment has the same fore and aft diameter as does the Vero tooth. At a distance of 55 mm. from this, toward the tip, the fore and aft diameter is 19 mm.; in the Vero specimen, only 16 mm. In *Smilodontopsis conardi* both edges are crenulated. In Cope's *Smilodon gracilis* [2] the powerful canine maintains well its breadth as the tip is approached; and both edges are free from denticles (Cope). For comparison there is figured here (pl. 28, fig. 4) a right canine tooth evidently belonging to *Dinobastis*

[1] Mem. Amer. Mus. Nat. Hist., vol. 9, p. 190. pl. 19.
[2] Journ. Acad. Nat. Sci. Phila., vol. 11, pl. 20, fig. 1.

serus Cope. It was found in a cave in the northern part of Bexar County, Texas. The tooth belongs to the Scientific Society of San Antonio. It was a far smaller tooth than that of figure 3.

From the close resemblance existing between the carnassial found at Vero and here referred to Leidy's *Machairodus floridanus* and that of *Trucifelis fatalis* found at Natchez, it is certain that both belong to the same genus. For this genus the writer accepts at present the name *Trucifelis*. We shall have, therefore, the two species, *Trucifelis atrox* and *T. floridanus*.

FELIS VERONIS, new species.

Plate 28, figs. 5–7.

When the author was at Vero, in October, 1917, he found along the drainage canal, a short distance above the railroad bridge, in the bed of sand known as No. 2, an upper left fourth premolar of a large tiger-like animal. Views of this tooth are here presented (pl. 28, figs. 5–7). On comparing it with the corresponding teeth of the tiger and of the jaguar (*F. paraguensis*, No. 4128 U. S. Nat. Mus.), and with those of the machairodonts, it can not be doubted that its possessor belonged to a species of *Felis*. In order to facilitate comparison the following measurements are presented, being those of the specimen in question, the same tooth of *Felis tigris*, and of the large South American jaguar, *Felis paraguensis* Hollister.

Measurements of carnassials of Felis.

	Felis from Vero.	*Felis tigris* 218321.	*Felis paraguensis* type.
Length of the crown	33.0	32.5	28.8
Width of crown at protocone	17.8	15.5	15.2
Width of crown between the main and the hinder cusps	12.5	10.0	10.2
Height of anterior lobe	10.0	11.0	11.0
Height of main cusp	16.0	15.0	16.0
Height of rear hinder lobe	7.0	6.0	6.0
Width of the main cusp	11.5	11.0	10.6

Various differences between the fossil tooth and that of the tiger appear other than those shown in the table of measurements. The protocone of the Vero tooth is considerably less reduced than in the tiger, its height and anteroposterior diameter being greater by one-third. Immediately behind the protocone the width of the tooth is reduced more suddenly than in the tiger; the preanterior tubercle is much more prominent than that in the tiger; and the buttress which descends from the principal cone to the protocone is sharp, instead of rounded. In the jaguar the preanterior tubercle is missing and the protocone is relatively more reduced than in the fossil. The height of the main cusp is relatively greater than in either the

recent tiger or the fossil one. Naturally, the fossil is very distinct from the jaguar because of its greater size.

From Natchez, Mississippi, Leidy described *Felis atrox*[1] which was based on a lower jaw with teeth. Inasmuch as the lower carnassial is 31.2 mm. long, while that of the existing tiger above-mentioned is only 23 mm., it is evident that *F. atrox* had upper carnassials which were about 44 mm. long. It was therefore a much larger animal than the Vero cat. *Felis augustus*,[2] besides belonging to the Arikaree of the Tertiary, differs in various ways from the Vero specimen. *Felis hillianus* Cope belongs to the Blanco Pliocene and is based on a canine tooth and some foot bones; so that it can not be compared with the animal here described. *Felis imperialis*, of the Pleistocene of California, had a second molar about 25.5 mm. long and was, therefore, a larger animal than that from Vero. According to Cope[3] the upper carnassial of *Felis inexpectata* has a length of 24 mm., being thus considerably smaller than that of the Vero animal.

Inasmuch as this large felid found at Vero appears to have been hitherto unknown, it is proposed to introduce it under the name *Felis veronis*.

TRICHECHUS ANTIQUUS Leidy?

Plate 26, figs. 2, 3.

In the collection of the National Museum is a part of the lower jaw of a manatee (Cat. No. 2522) which is labeled as having been found with the other fossils of the Alachua clays, in Levy County. However, the writer finds no reference to this genus in any of the lists of materials collected in the Alachua clays; the fossil has an appearance different from most of the other fossils of those clays; and there is attached to it an oyster shell, showing that it had lain in salt water. Doctor Sellards informs the writer that he has never seen any marine fossils that have been found in the Alachua clays. It is hence probable that the bone was found somewhere else in Florida. Leidy reported[4] fragments of ribs of supposed *Trichechus antiquus* from Peace creek, and Sellards[5] included *T. manatus* among the fossils found in Withlacoochee river. No mention is found of the discovery of a lower jaw at any place.

The jaw in question appears to be well fossilized and it is heavy; so that it evidently belongs to either the Pleistocene or to some late Tertiary deposit.

The jaw lacks both ascending rami and all of the teeth. It evidently belonged to a species of *Trichechus*, but not to *T. manatus*. The individual possessing it appears to have had a size somewhat less than that of a manatee whose basilar length is 356 mm. The

[1] Trans. Amer. Philos. Soc., vol. 10, 1853, p. 319, pl. 34.
[2] Leidy, Ext. Vert. Fauna, etc., pl. 7.
[3] Journ. Acad. Nat. Sci. Phila., vol. 11, p. 248.
[4] Trans. Wagner Inst., vol. 2, p. 27.
[5] 8th Ann. Rep. Fla. Geol. Surv., p. 104.

distance from the front of the symphysis to the rise of the ascending ramus was close to 180 mm; in the jaw of the existing manatee with which it is compared this dimension is 195 mm. The length of the symphysis is relatively the same as in the manatee. Its greatest height is 68 mm.; in the manatee, 83 mm. In the latter animal the upper half of the hinder face of the symphysis forms a concavity; this does not exist in the fossil jaw. The surface which in life was occupied by the horny plate is relatively much shorter than in the manatee, being only 60 mm. long; in the manatee, 80 mm. In the manatee the inner face of the horizontal ramus is flat or even concave; this does not seem to have been the case in the fossil jaw. The height of the jaw was evidently less than in the existing manatee, being apparently only 48 mm. at the middle of the length; whereas in the only slightly larger manatee jaw the height is 60 mm. The inferior dental canal is considerably larger than in the manatee, its diameter being 17 mm. Moreover, its outer face is open backward to about the position of the third or fourth tooth.

Judging from what remains of the sockets of the teeth the latter had a length somewhat greater than in the existing manatee. Three of these sockets occupy a line 45 mm. long; in the manatee used for comparison, 41 mm. The lower teeth appear to have been wider than those of the manatee, but of this one can not be certain.

Leidy described an upper tooth of a manatee which bears the name *Trichechus antiquus*, and which was found at Charleston, South Carolina. The fore and aft diameter of the tooth was about 20 mm.; that of the existing manatee is about 12.5 mm. *T. antiquus* was evidently a much larger animal. Its lower teeth must have had a length of about 24 mm. Evidently the jaw supposed to have been found at Williston belonged to a considerably smaller individual, perhaps to a smaller species, than the one which furnished Leidy's type. In the various species belonging to the genus *Trichechus* there is a continuous succession of teeth which are produced at the rear of the jaw and which move forward. These increase in both length and width as the animal grows. Hence the tooth described by Leidy may have belonged to a very large specimen of the same species as that to which the jaw belonged which is above described. For that reason the jaw is referred provisionally to *Trichechus antiquus;* but it may, with equal probability, have belonged to an undescribed species.

ATRACTOSTEUS LAPIDOSUS, new species.

Plate 26, fig. 4; plate 28, fig. 8.

In the United States National Museum are a right opercular bone and some scales of a fresh-water gar which are labeled as having been found by L. C. Johnson, in 1885, in the "Mixon bone bed," in

Levy County, Florida. This place is near the present town of Williston. These gar remains are doubtless those mentioned by Leidy in 1896.[1] An examination of these shows that they belonged to a fish closely related to that known as alligator gar, usually called *Lepisosteus tristoechus*. However, this gar appears to the writer to be generically distinct from the long-snouted gar and hence to be called *Atractosteus* Rafinesque. The fossil materials from Williston are referred to this genus and may be known as *Atractosteus lapidosus*. The opercular bone is made the special type of this species. It can hardly be doubted that the scales belonged to the same individual fish. In case the opercular bone had the same length, proportioned to the remainder of the body, as in a specimen of *A tristoechus* the total length of the fish was close to 27 inches.

The opercular is represented of the natural size by figure 4 of plate 26. The height near the front border is 26.5 mm.; the length is 24 mm. The corresponding dimensions of this bone in a specimen of the existing alligator gar are 54 mm. and 54 mm. This bone also is shown, reduced to the same size for comparison (pl. 26, fig. 5). It belonged to the left side of the head. The fossil bone is entire, except that a small fragment is missing, the loss of which has produced the notch in the lower border. It will be seen that there are some differences in the shape of the two bones. The greatest difference is found, however, in the character of the sculpture. That of the fossil differs in consisting of more regular, more continuous, and more sharply defined ridges descending from the upper angle of the bone. The ridges of the existing fish consist of a sort of network of low ridges, especially on the front half of the bone. Also the ridges of the front half are directed downward or downward and backward, while in the fossil they turn somewhat forward in their descent. In the existing fish the ridges of the front half are more widely separated than those in the hinder part; in the fossil they are narrower and more closely packed.

Ten of the scales are here represented of the size of nature (pl. 28, fig. 8). It will be seen that some of them have the upper hinder border toothed, while others have this border smooth. In these respects they resemble the scales of the existing alligator gar (pl. 28, fig. 9) except that there appear to be fewer of the teeth. Both *Lepisosteus osseus* and *L. platystomus* have the borders of all the scales smooth; at least the writer has not found toothed scales in either of these species.

[1] Trans. Wagner Free Inst. Sci., vol. 4, page x.

EXPLANATION OF PLATES.

PLATE 26.

FIG. 1. *Elephas imperator.* Hindermost left lower molar. × ⅜.

2, 3. *Trichechus antiquus?* Lower jaw. × ½.

2. View of left side.

3. View from above.

4. *Atractosteus lapidosus.* Right opercular bone; outer surface. × 1.

5. *Atractosteus tristoechus.* Left opercular bone; outer surface. Reduced.

PLATE 27.

FIGS. 1, 2. *Thinobadistes segnis.* Left astragalus. × ¾.

1. View of upper face.

2. View of lower face.

3, 4. *Gnathopsis oweni.* Left astragalus. × ½.

3. View of upper face.

4. View of lower face.

a, external; *b*, internal, portion of tibial articular surface; *c*, articular surface for navicular; *d*, articular surface for cuboid; *e*, anterior; *f*, posterior surface for calcaneum; *g*, articular surface for fibula.

PLATE 28.

FIGS. 1–3. *Trucifelis floridanus.* Teeth. × 1.

1. Left upper carnassial. Inner view.

2. Same tooth. Outer view.

3. Fragment of upper canine.

4. *Dinobastis serus.* Right canine. × 1.

5–7. *Felis veronis.* Left upper carnassial. × 1.

5. Outer view.

6. Inner view.

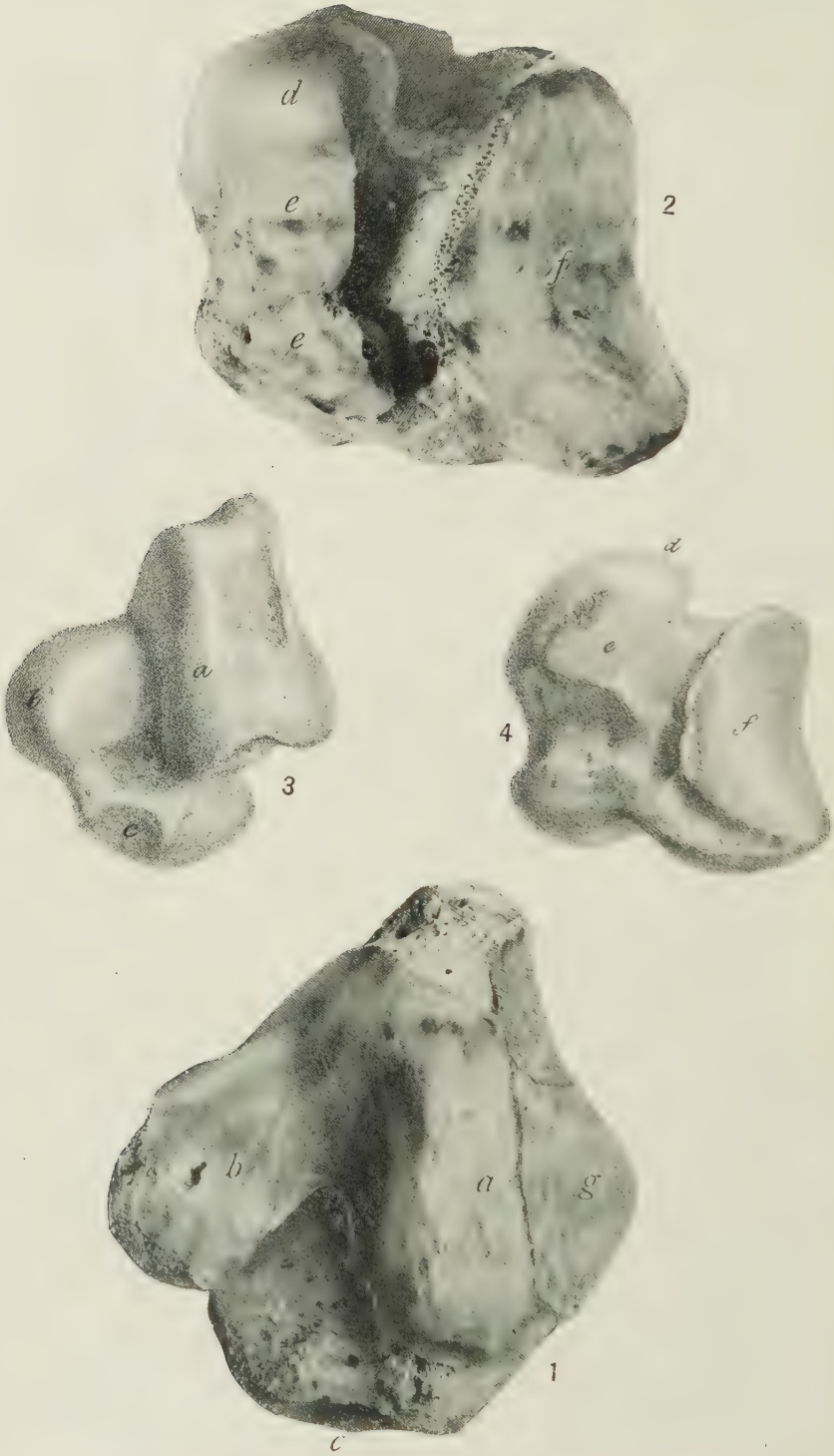
7. View of cutting border.

8. *Atractosteus lapidosus.* Scales. × 1.

9. *Atractosteus tristoechus.* Scales. × 1.

MAMMALIAN AND FISH REMAINS FROM FLORIDA

FOR EXPLANATION OF PLATE SEE PAGE 112



MAMMALIAN REMAINS FROM FLORIDA

FOR EXPLANATION OF PLATE SEE PAGE 112

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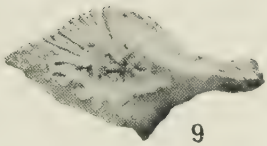

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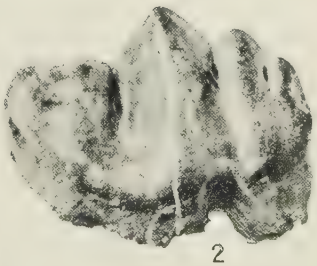

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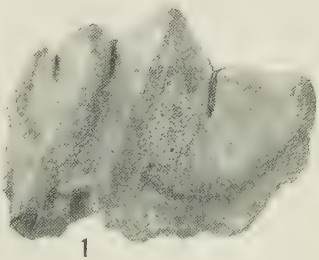

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MAMMALIAN AND FISH REMAINS FROM FLORIDA

FOR EXPLANATION OF PLATE SEE PAGE 112

NEW FOSSIL TURTLES, WITH NOTES ON TWO DESCRIBED SPECIES.

By Charles W. Gilmore.
Associate Curator, Division of Paleontology, United States National Museum.

INTRODUCTION.

During the summer of 1918 the Section of Vertebrate Paleontology of the United States National Museum came into the possession of a considerable number of well-preserved turtle specimens. Among these are several that represent undescribed species and others that contribute to a better understanding of the skeletal structure of described forms.

It is the purpose of the present paper to present the facts concerning these specimens, thus making this information available to students of the extinct Chelonia.

Family PLEUROSTERNIDAE.

NEURANKYLUS WYOMINGENSIS, new species.

Plates 29 and 30.

Type.—No. 7581, U.S.N.M., consists of the posterior half of the carapace and plastron.

Type locality.—Shoshone River, near Cody, Big Horn County, Wyoming.

Horizon.—Colorado shale, Upper Cretaceous.

The specimen to be described was collected in the summer of 1912 by Mr. D. F. Hewett, of the United States Geological Survey, from the Colorado shale as exposed in the vicinity of Cody, Wyoming.

A comparison of this somewhat imperfect specimen with the type of *Neurankylus baueri* also in the National Museum collection, leads me to provisionally refer it to that genus. The large size and general proportions of the vetebral and costal scutes, and the close resemblance in the general form of both the carapace and plastron appears to show the correctness of the above determination. If, upon the discovery of more perfect specimens, this provisional assignment proves to be correct, it represents the most ancient member of the

genus *Neurankylus* yet discovered. The other two species, *N. eximus* Lambe, being from the Belly River formation of Canada, and *N. baueri* Gilmore, from the Kirtland formation of New Mexico.

All of the carapace in front of the posterior half of the second vertebral scute is missing; likewise, all of the plastron slightly in advance of the inguinal notches. The shell has been pressed flat dorsoventrally, but the outlines of the part preserved appear to be but little distorted, and undoubtedly give a correct conception of the form of the shell. None of the sutures between the bones can now be observed, all traces being obliterated by their complete coalescence, due, no doubt, to the old age of the individual. The sulci defining the dermal scutes, however, can in most instances be clearly made out, as shown in Plate 29.

The presence of an ornamentation over all the external surfaces of the shell at once distinguishes this form from the two species mentioned above. This sculpture is composed of low, flat-topped ridges and elevations, the ridges usually being wider than the intervening valleys, which are often threadlike. They form rather a uniform roughening of the surface but do not have any definite pattern.

There is no indication of an interrupted median carina such as is present in the neural region of *N. baueri*.

The presence of this ornamentation over the external surfaces of the shell, the relatively narrower vertebrals, and relatively wider posterior plastral lobe with a truncated posterior end, constitute a combination of characters indicating the distinctness of this specimen from the other described forms and the name *Neurankylus wyomingensis* is proposed for its reception.

In form the part of the carapace preserved resembles that of *N. baueri* being broadly but evenly rounded, not scalloped, as in the former species, except that they agree in having a wide posterior median notch. It is estimated that the length of the entire shell was about 530 millimeters; the greatest width is 475 millimeters. The border anterior to the inguinal notches is thickened and rounded, but posteriorly it becomes thinner, though the edges are obtusely rounded, not having the thin acute border of *N. baueri*. There was probably a slight flaring upward of the peripheral bones, though they have been quite flattened by the pressure to which they were subjected.

The sulci are narrow and faintly impressed. The vertebral scutes are relatively narrower than in either *N. eximus* Lambe or *N. baueri* Gilmore. The principal dimensions of these scutes are given in the table.

Comparative measurements of vertebral scutes in millimeters.

No.	Length.			Width.		
	N. wyomingensis.	*N. baueri.*	*N. eximus.*	*N. wyomingensis.*	*N. baueri.*	*N. eximus.*
3	108	110	78	142	167	138
4	96	114	72	115	140	111
5	90[e]	108	.....	135	117	.....

[e] Estimated.

The supracaudal scute was probably divided as in *Neurankylus baueri*. At the center they measure 17 millimeters in length.

Assuming that in the complete series there are 11 marginal scutes, as in *N. baueri*, in this specimen the sixth to the eleventh of both sides are present. The eighth is 80 millimeters long, 62 millimeters high; ninth, 60 millimeters long, 66 millimeters high; tenth, 65 millimeters long, 53 millimeters high; eleventh, 65 millimeters long, and 52 millimeters high.

Costal scutes three and four are broader than long, whereas in *N. baueri* they are as broad as long. This difference in proportion is indicated by the relatively narrower vertebrals.

The surface of the plastron has practically the same ornamentation as that on the carapace. None of the sutures on this aspect of the shell are now visible, and only the abdominal-femoral sulcus can be made out. At the center it crosses at a point 197 millimeters in advance of the posterior end of the hinder lobe. The posterior lobe at the base has a width of 185 millimeters. Its length at the center is 142 millimeters. The lateral borders converge from the inguinal notches back to the truncated end which measures 90 millimeters in width. This end is undulating as shown in Plate 30. The lateral borders present subacute edges but thicken rapidly toward the center. The posterior end of this lobe reaches within 60 millimeters of the median posterior border of the carapace. The inguinal buttress is attached low down on the costals.

Neurankylus wyomingensis is distinguished at once from the other species of the genus in having a sculptured shell, and relatively narrower vertebrals. From *N. baueri* it differs further by the apparent absence of a median dorsal carina, by the evenly rounded posterior border without scallops, the rounded obtuse edges of the posterior peripherals, and the relatively wider and more angular truncated end of the posterior lobe of the plastron.

Family BAENIDAE.

BAENA ANTIQUA Lambe.

Plates 31 and 32.

Baena antiqua LAMBE, Contrib. Canad. Paleontology, vol. 3, 1902, pp. 44, figs. 10, *a*, *b*.—Hay, Fossil Turtles of North America, 1908, pub. Carnegie Institution, Washington, pp. 62–63, text-figs. 37, 38.

A Baenid turtle acquired by the United States National Museum from Mr. C. H. Sternberg is here provisionally identified as pertaining to *Baena antiqua* Lambe. Except for its smaller size, in so far as a comparison can be made with the rather fragmentary type of the species, it shows close similarity in nearly all details. If the identification is correct, as there is reason to believe, the specimen before me is of importance in contributing much to our knowledge of the skeletal anatomy of this little known species.

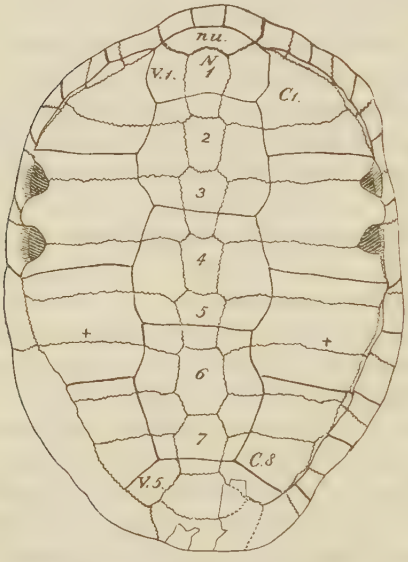


FIG. 1.—CARAPACE OF BAENA ANTIQUA LAMBE. No. 8801, U.S.N.M. *C.1. C.8.*, COSTAL BONES ONE AND EIGHT; *N. 1, 2, 3, 4, 5, 6, 7*, NEURAL BONES ONE TO SEVEN; *nu.*, NUCHAL; *V. 1., V. 5.*, VERTEBRAL SCUTES ONE AND FIVE. + INDICATES POSITION OF INGUINAL BUTTRESSES. ONE THIRD NATURAL SIZE.

The specimen, No. 8801, U.S. N.M., consists of the almost complete carapace and plastron, the latter lacking the anterior lobe. It was collected by Bruce McKee in 1917, 3 miles below Steveville on the Red Deer River, Province of Alberta, Canada, in the Belly River formation, Upper Cretaceous.

The carapace is broadly rounded in front with a narrowed and truncated posterior extremity. It has an extreme length at the center of 222 millimeters, whereas Lambe estimates the type as being 290 millimeters in length. The greatest breadth of No. 8801 is 167 millimeters which is slightly forward of the inguinal notches. In most Baenids the greatest transverse diameter is posterior to this notch. From the inguinal notches the sides of the carapace round in rapidly to a shallow indentation half way to the posterior end, there less rapidly to the straight truncated end. Except for the one indentation mentioned above there are no scallops on the posterior margins. There is a slight median projection of the nuchal plate on the anterior border which is also slightly undulating, as in the type

specimen. The carapace is evenly and broadly arched from side to side.

The nuchal at the center is 19 millimeters long, with a greatest breadth of 40 millimeters. There are only seven neurals determinable, the seventh being the largest the sixth being octagonal. The seventh, in all probability, is the coalesced seventh and eighth, but no suture can be seen crossing it.

In the number of neurals the large size of the seventh and the octagonal shape of the sixth this specimen closely resembles *B. riparia* Hay. As in the type all of the neurals are longer than wide.

Measurement of neurals of Baëna antiqua in millimeters.

No.	Length.		Width.	
	No. 8801, U.S.N.M.	Type.	No. 8801, U.S.N.M.	Type.
1	30	33	18	27
2	21	30	16	28
3	25	37	17	30
4	21	32	15.5	22
5	22	31	18	26
6	25	.....	17.5	.....
7	25	.....	20.5	.....

The pygal is unusually long, measuring 32 millimeters anteroposteriorly, with a greatest transverse diameter of 44 millimeters. On the free border it is 30 millimeters wide.

There are the usual eight pairs of costals. All except the fifth pair have the distal end wider than the proximal—a peculiarity apparently found in the type of the species as shown by the converging sides of the proximal half, the distal part of which is missing. At the junction of costals 2 and 3, and 3 and 4 with the peripherals, there are two suboval openings through the carapace. The contraction of costal 3 to a broadly pointed end, which is received in a pit largely within peripheral 5, separates these two apertures. The anterior opening is the smaller of the two. These may possibly be attributed to the immaturity of the individual, and in an aged specimen it is not unlikely that these openings would cease to exist.

The axillary buttress is directed upward and forward toward the front of the first dorsal vertebra. Its upper end joins the first rib, which is wide, and with the buttress forms the extended partition bounding the body chamber. The inguinal buttress unites exclusively with the fifth costal on its distal half (see fig. 1). In front of it the body chamber extends far out toward the border of the carapace. There are 11 peripheral bones, all of which are relatively low. The first two are 17 millimeters high; the third, 21 millimeters; the three succeeding increase from 12 to 14 millimeters; the seventh,

21 millimeters; the eighth, 23 millimeters; the ninth, 18 millimeters; the tenth, 13 millimeters; the eleventh, 15 millimeters.

The sulci defining the dermal scutes are shallowly impressed, but all except the posterior part of the costomarginal sulcus can be clearly traced, as shown in figure 1.

The vertebrals, as in all other known Belly River (Judith River) Baenids, are wider than long. The principal dimensions of these as compared with the type are shown in the table:

Measurements of vertebrals of Baëna antiqua, in millimeters.

No.	Length.		Width.	
	No. 8801, U.S.N.M.	Type.	No. 8801, U.S.N.M.	Type.
1	28	40	49	73
2	47	62	50	70
3	45	66	53	75
4	51		53	
5	39.5		54	

There are four costal scutes on each side. These extend well down on the shell, the costomarginal sulcus along the side, apparently running with the costoperipheral suture, the center though below it in front and apparently also behind.

No supernumerary costal scutes are present. The nuchal is rectangular in shape, 15 millimeters wide and 9 millimeters long.

The plastron lacks the anterior end and can not, therefore, be compared with the typical specimen, which consists only of the anterior lobe. The posterior lobe has a length of 64 millimeters; a width at the base of 72 millimeters. Posteriorly from the inguinal notch the lateral borders of the lobe, which are straight, gradually converge to the truncated posterior end that measures 36 millimeters in width. This end terminates 36 millimeters anterior to the median posterior end of the carapace. The shallow concave surface of the plastron suggests that this individual may have been a male. Behind the inguinal notch the plastron has a thickness of 10 millimeters, but at the posterior extremity it reduces to only 3 millimeters. At the center the plastron has an extreme width of 134 millimeters; the bridge a width of about 91 millimeters. There are well-developed mesoplastrals that meet on the median line for 17 millimeters. The lateral ends expand to a width of about 35 millimeters. The hypoplastrals join along the median line for a distance of 55 millimeters; the xiphiplastrals for 31 millimeters.

The abdominals meet on the median line for 28 millimeters; femorals for 42 millimeters; anals for 34 millimeters. There are four inframarginal scutes on each bridge; these lie almost entirely on the plastral bones.

Baëna antiqua Lambe now appears to be distinguished from all other members of the genus, except *B. callosa* Hay, by the proportion of the posterior lobe, especially the straightness of its sides and the squarely truncated end without posterior median notch, and the contracted posterior part of the carapace without a scalloped border. The perforations of the shell at the ends of costals 2, 3, and 4, may also be useful in distinguishing this species if these openings prove not to be a juvenile feature. From *B. callosa* Hay also from beds of equivalent age, the fragmentary character of the type specimen renders its separation somewhat more difficult, though the smaller size and differences in the proportions of the vertebrals and posterior lobe of the plastron would appear to show the distinctness of *B. antiqua*.

BOREMYS ALBERTENSIS, new species.

Plates 33 and 34.

In 1906 Mr. L. M. Lambe, of the Geological Survey of Canada, established[1] the genus *Boremys*, selecting as the genotype a specimen from the Belly River formation as exposed on the Red Deer River, Alberta, Canada, previously referred by him to Leidy's genus *Baena*. The genus *Boremys* was characterized as follows:

"Supramarginal shields present in the carapace; mesoplastra well developed, in contact in the median line for some distance; intergular shield divided; inframarginal shields present on the bridges."

Later the discovery of additional materials enabled Lambe to give a detailed description of the entire carapace of *Boremys pulchra*.[2]

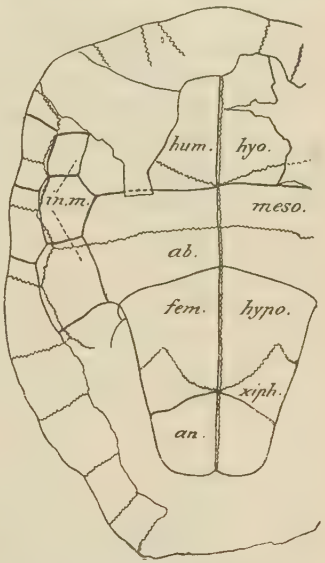


FIG. 2.—PLASTRON OF BAËNA ANTIQUA LAMBE. No. 8801, U.S.N.M. *ab.*, ABDOMINAL SCUTE; *an.*, ANAL SCUTE; *fem*, FEMORAL SCUTE; *hum.*, HUMERAL; *hyo.*, HYOPLASTRON; *hypo.*, HYPOPLASTRON; *in. m.*, INFRAMARGINAL SCUTES; *meso.*, MESOPLASTRON; *xiph.*, XIPHIPLASTRON. LESS THAN ONE-THIRD NATURAL SIZE.

A turtle specimen recently acquired by the United States National Museum from Mr. C. H. Sternberg, which was obtained by him from the Belly River formation, shows characters which definitely distinguish it from Lambe's species, and the name *Boremys albertensis* is here proposed for its reception.

Type.—No. 8803, U.S.N.M., consists of the anterior three-fourths of the carapace and practically the complete plastron. Collected by Levi Sternberg, 1917.

[1] Lambe, L. M. Ottawa Naturalist, vol. 19, No. 12, Mar., 1906, pp. 232–234.
[2] Lambe, L. M. Trans. Royal Soc. of Canada, vol. 8, 1914, pp. 13–16; text-fig. 14.

Type locality.—South Branch of Sand Creek, Province of Alberta, Canada.

Horizon.—Belly River formation ("200 feet below the top"), Upper Cretaceous.

The characters which distinguish *Boremys albertensis* from *B. pulchra* Lambe may be summarized as follows: Larger size (nearly one-third); additional supramarginal scute separating first costal from marginals; supramarginals wider than long; diameter of costal

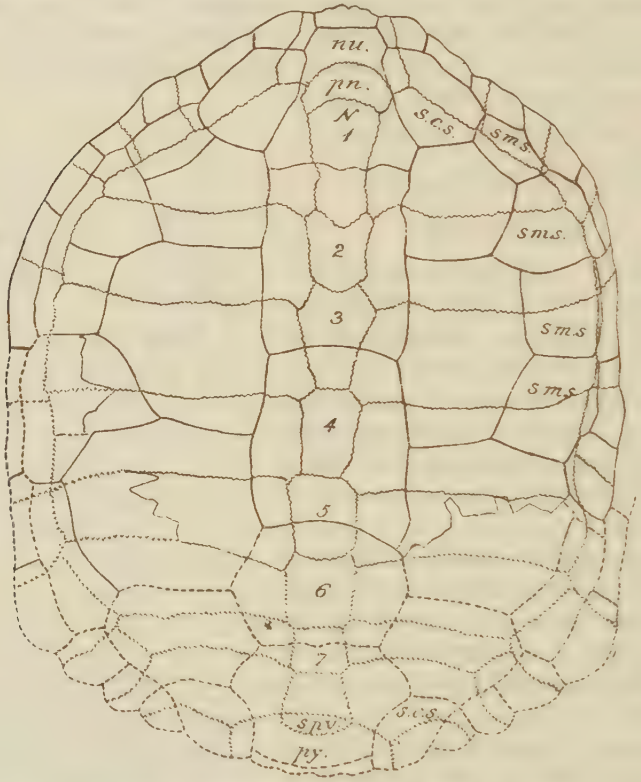


FIG. 3.—CARAPACE OF BOREMYS ALBERTENSIS, NEW SPECIES. TYPE NO. 8803, U.S.N.M. *N. 1, 2, 3, 4, 5, 6, 7,* NEURAL BONES ONE TO SEVEN; *nu.*, NUCHAL; *pn.*, PRENEURAL; *py.*, PYGAL; *s. c. s.*, SUPERNUMERARY COSTAL SCUTES; *s. m. s.*, SUPRAMARGINAL SCUTES; *spy.*, SUPRAPYGAL. ABOUT TWO-FIFTHS NATURAL SIZE. RESTORED.[1]

scutes reduced transversely, median scute longer than wide; first vertebral elongated; carapace more pointed, not broadly rounded in front, first neural greatly elongated; inframarginals wider than long; intergulars overlapping entoplastron.

Except for the parts that are missing the carapace is well preserved. All the sutures between the bones and the scutes can be clearly made out.

[1] The posterior end of carapace restored from *Boremys pulchra* Lambe; see fig. 14., Trans. Royal Soc. of Canada, vol 8, 1914, pp. 13-16.

Compared with *B. pulchra* the carapace has a more pointed anterior end and a less sinuous margin. It is estimated that the shell had a greatest length of about 280 millimeters with a greatest width of 244 millimeters. It is moderately arched transversely. The surface of the carapace is slightly sculptured by a combination of nodes and ridges. A low rounded inconspicuous, interrupted, longitudinal ridge extends along the median line of the neural bones. On several of the neurals there are on either side numerous oblique ridges and grooves all faintly indicated. Several node-like elevations occur here and there along the front peripheral margin, and less well-defined ones are scattered over the surfaces of the costal bones. The plastron is smooth.

The nuchal has a greatest width of 44 millimeters, which is reduced to 31 millimeters on the margin; the length is 20 millimeters. It is broadly excavated behind for the reception of the broad convex end of the preneural. Neurals 1 to 5 are present in this specimen, and all are wide in front, but with much narrowed posterior ends. The first, as compared with *B. pulchra*, is greatly elongated. Their principal dimensions are given in the table:

Measurement of neurals in millimeters.

No.	Length.	Width.
Preneural	13	29
Neural 1	41	24
Neural 2	20	21
Neural 3	31	24
Neural 4	30	22
Neural 5	28	22

The fifth costal narrows to its distal end as in *B. pulchra*. The peripheral bones present are mostly quadrangular in shape, except the first, which is triangular and very small. The second and third are about as long as high, but the succeeding ones, including the eighth, are longer than their height.

The nuchal scute is smaller than in *B. pulchra*, measuring 20 millimeters wide and 7 millimeters fore and aft.

The first vertebral scute is as broad as long, whereas in *B. pulchar* it is nearly twice as broad as long. This scute is also characteristic in being greatly narrowed toward the front. Posteriorly it has a greatest width of 49 millimeters, which reduces to 19 millimeters at the anterior end.

Measurements of vertebrals, in millimeters.

No.	Length.	Width.
1	49	49
2	56	47
3	59	50

The costal scutes are reduced in size, due to the enlargement of the supramarginals. The second is much longer (fore and aft) than broad, whereas this same scute in *B. pulchra* is wider than long. The area of the first costal scute is also greatly reduced, due principally to the presence of an extra supramarginal which separates it from contact with the marginals. There is a large subtriangular supernumerary costal scute (see *s. c. s.*, fig. 3) as in *B. pulchra* and such as is often present in other members of the Baenidae.

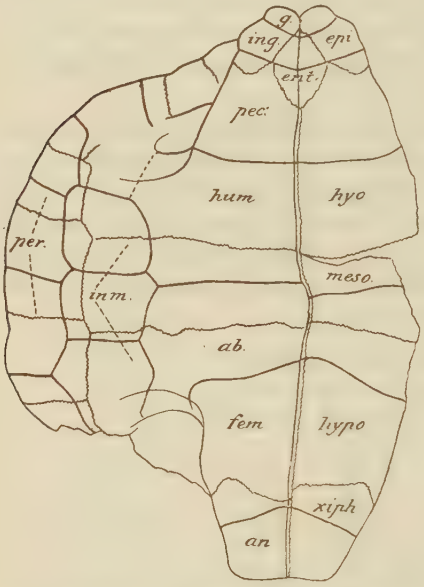


FIG. 4.—PLASTRON OF BOREMYS ALBERTENSIS, NEW SPECIES. TYPE. NO. 8803, U.S.N.M. *ab.*, ABDOMINAL SCUTE; *an.*, ANAL SCUTE; *ent.*, ENTOPLASTRON; *epi.*, EPIPLASTRON; *fem.*, FEMORAL SCUTE; *g.*, GULAR SCUTE; *hum.*, HUMERAL SCUTE; *hyo.*, HYOPLASTRON; *hypo.*, HYPOPLASTRON; *ing.*, INTERGULAR; *in. m.*, INFRAMARGINAL SCUTES; *meso.*, MESOPLASTRON; *pec.*, PECTORAL SCUTES; *per.*, MEDIAN PERIPHERALS; *xiph.*, XIPHIPLASTRON. ONE-THIRD NATURAL SIZE.

The supramarginal scutes are in a row, alternating with the costal scutes, between them and the marginals. These are exceptionally wide, all except the first being wider than long. In the genotype the opposite condition prevails.

The marginal scutes are all longer than high, and those bordering the supramarginals appear relatively wider than in *B. pulchra*. The marginal-supramarginal sulcus back as far as the eighth runs well below the costo-peripheral suture. On the fourth costal this sulcus suddenly rises above this suture.

The plastron (fig. 4) is longer than wide, with rather narrow lobes. It has a greatest length of 222 millimeters, with a greatest breadth at the center of 186 millimeters. The bridge has a width fore and aft of 101 millimeters. The anterior lobe is 64 millimeters long and 94 millimeters wide at the base. The width diminishes quite rapidly from the base anteriorly, the end being rounded with sinuous borders caused by indentations where the sulci come to the edge. The posterior lobe is 70 millimeters long and 84 millimeters wide at the base. The lateral borders are nearly straight and convergent to the squarely truncated end, that has a width of 45 millimeters. The lateral edges are obtuse, but the bone thickens rapidly toward the median line. Just behind the inguinal notch it reaches a thickness of 14 millimeters; near the posterior extremity, 7 millimeters.

The entoplastron is diamond-shaped, as in *B. pulchra*. It is 30 millimeters long and 20 millimeters wide. At the center the hyoplastrals meet on the mid line for 58 millimeters. The mesoplastra are large. At the center the right element is wider (32 millimeters) then the left (24 millimeters). The right element has a greatest transverse diameter of 93 millimeters. At the outer end it measures 28 millimeters fore and aft. The hypoplastrals join on the midline 64 millimeters; the xiphiplastrals for 34 millimeters.

The small intergulars slightly overlap the anterior end of the entoplastron. The larger gulars meet on the median line for 13 millimeters; the humerals for 38 millimeters; the pectorals for 45 millimeters; the abdominals for 33 millimeters; the femorals for 50 millimeters; and the anals for 29 millimeters. In having the anal scutes confined exclusively to the xiphiplastral bones *Boremys* differs from most of the other members of the Baenidae, *Baena hatcheri* being one of the notable exceptions.

On the bridge are four large inframarginal scutes, as in *B. pulchra*, but they differ from those of that species in that all are wider than long. These scutes lie principally on the plastral bones, only extending over slightly on the median peripherals.

As has been previously pointed out it is in the arrangement and proportion of the dermal scutes that the principal characters are found for distinguishing this species from *Boremys pulchra* Lambe, but these appear to be sufficient to indicate their dissimilarity.

Family DERMATEMYDIDAE.

AGOMPHUS ALABAMENSIS, new species.

Plate 35.

Type.—No. 8806, U.S.N.M., consists of the anterior half of the carapace and plastron. Collected by Dr. E. H. Sellards, 1908.

Type locality.—Moscow Landing, Tombigbee River, Alabama.

Horizon.—Midway formation. Lower Eocene.

The specimen to be described is of more than ordinary interest on account of coming from a geological formation in which but few vertebrate specimens have been found. The carapace as preserved without crushing is highly arched both transversely and anteroposteriorly. The posterior half of the shell is missing, being cut off obliquely at the posterior end of the fourth neural, so that there is much more of the left side of the carapace preserved than there is of the right. At the center, the height of the shell is 185 millimeters. It is estimated that its greatest width was about 280 millimeters. It will be observed from these measurements that this specimen is a considerably larger individual than the type of *Agomphus oxyster-*

num[1] (Cope) from this same formation, as exposed near Montezuma, Macon County, Georgia.

The sulci defining the first vertebral scute and the costo-marginal contact are the only ones that can be traced, though the sutures between the bones can nearly all be clearly made out as shown in figure 5.

The shell, both carapace and plastron, are thick and heavy. The free border in front, is obtuse and flares upward. The nuchal plate has a length antero-posteriorly of 52 millimeters; a greatest width of about 64 millimeters. The neurals are especially elongated, hexagonal in shape, with the widest end forward, all being longer than wide, whereas in *A. oxysternum* they are wider than long. The principal dimensions of the neurals are given in the table.

Measurements of neutrals, in millimeters.

No.	Length.	Width.
1	54	21 *e*
2	40	23
3	46	24
4	46 *e*	21

e Estimated.

The first costal has a greatest length of 92 millimeters, a width of 72 millimeters; the second is 100 millimeters long, and 42 millimeters wide at the proximal end; third is 120 millimeters long, and 44 millimeters wide at proximal end; fourth 126 millimeters long, and 42 millimeters wide; fifth is about 125 millimeters long. Excepting the first, the other costals present in the type are remarkably uniform in the widths of the proximal and distal ends.

The peripherals are high and all unite closely and strongly by suture with the distal ends of the costals. At about their centers they are crossed by the costo-marginal sulcus. On the ventral side of this sulcus the bone swells abruptly outward forming a prominent offset along the side of the shell, but not a ridge as in the genus *Hoplochelys*. Peripheral 6 has a width fore and aft of 42 millimeters; 7 is 43 millimeters wide.

The surface of the shell is without ornamentation, except for a broad rounded median longitudinal keel which is paralleled on each side, at a distance of 35 millimeters, by lateral keels. The median keel appears to rise close to the anterior border of the nuchal plate. These keels resemble somewhat those found on the carapace of *Hoplochelys saliens* Hay, but are less prominent, being lower and more rounded, as contrasted with the higher and sharper keels of that species.

[1] See Hay, O. P., Fossil Turtles of North America, 1908, p. 256, fig. 256.

The first vertebral scute is 71 millimeters long and its anterior end is 57 millimeters wide. The sulci bounding the other vertebrals can not be observed.

The plastron is rather poorly preserved, lacking the whole of the posterior lobe and much of the right side. The anterior lobe narrows rapidly from the base to the blunt anterior end, as in *A. masculinas* Wieland. The anterior lobe has a length of about 75 millimeters, a width at the base of 116 millimeters. The epiplastrals are narrow. The entoplastron is broadly rounded behind and pointed in front, as in *A. oxysternum* (Cope). It measures 42 millimeters in length and 40 millimeters in width. The bridge has a width of 90 millimeters. The anterior lobe in front turns up slightly from the level of that portion between the bridges. None of the sulci on the plastron or the sutures posterior to the entoplastron can be made out.

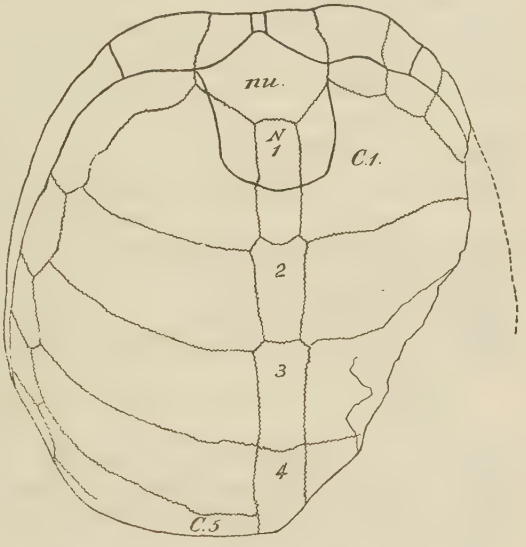


FIG. 5.—ANTERIOR HALF OF CARAPACE OF AGOMPHUS ALABAMENSIS, NEW SPECIES. TYPE NO. 8806, U.S.N.M. *C. 1, C. 5*, COSTAL BONES ONE AND FIVE; *N. 1, 2, 3, 4*, NEURAL BONES ONE TO FOUR; *nu.*, NUCHAL BONE. ONE-THIRD NATURAL SIZE.

Seven species belonging to the genus have been described, all based on rather fragmentary materials. Excepting *A. oxysternum* (Cope), from the Midway formation of Georgia, all the others have been founded on specimens from the Upper greensand bed, Upper Cretaceous of New Jersey. The presence in *Agomphus alabamensis* of three low broad, parallel, longitudinal keels, and with neurals longer than wide appears to distinguish this form from all other described species. Its much larger size may also prove of assistance in distinguishing this species from *A. oxysternum*, the species to which the present specimen is in all probability most nearly related.

Family EMYDIDAE.

ECHMATEMYS MEGAULAX (Cope).

Plate 36.

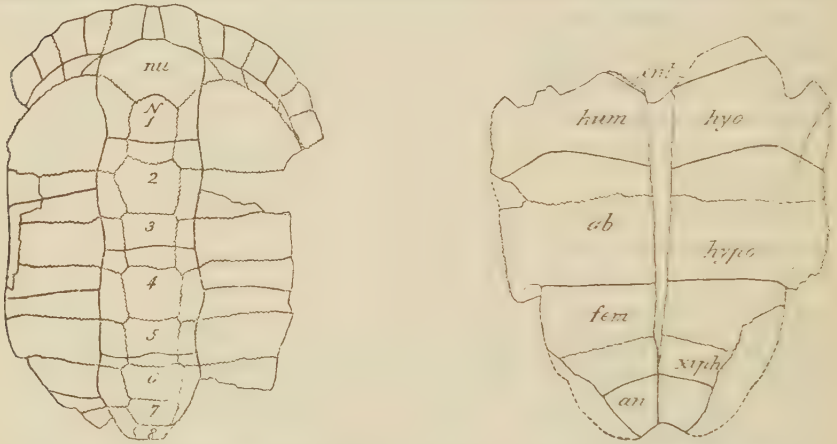
In 1872 Cope[1] described the above species, basing it on five or six fragmentary specimens. Portions of some of these are now in the

[1] Sixth Ann. Rept. U. S. Geol. Surv. Terr., 1872 (1873) p. 628.

American Museum of Natural History and at least two, Nos. 4061 and 4121, the former, which was figured [1] by Cope, now belongs to the United States National Museum collections. These cotypes and other specimens were collected in the Green River beds of the Wasatch formation, at Black Buttes, Wyoming.

In 1908 Hay [2] redescribed these cotypes and other materials and figured some additional parts.

The typical material is quite inadequate so far as giving a clear conception of the bony structure and the true relationships of the species, and the provisional recognition of a more perfect specimen in the United States National Museum collections here referred to



FIGS. 6 AND 7.—ECHMATEMYS MEGAULAX (COPE). No. 7316 U. S. N. M. (6). CARAPACE. *N. 1, 2, 3, 4, 5, 6, 7, 8,* NEURAL BONES ONE TO EIGHT *nu.* NUCHAL (?)., PLASTRON, *ab.,* ABDOMINAL SCUTE., *an.,* ANAL SCUTE; *ent.,* SUTURAL SURFACES FOR ENTOPLASTRON; *fem.,* FEMORAL SCUTE; *hum;* HUMERAL SCUTE; *hyo.,* HYOPLASTRON; *hypo.,* HYPOPLASTRON; *xiph.,* XIPHIPLASTRON. BOTH FIGURES ONE-HALF NATURAL SIZE.

Echmatemys megaulax (Cope) is a welcome addition to our knowledge of this species.

This specimen (No. 7316) was collected by Mr. D. F. Hewett of the United States Geological Survey in 1911 from the Wasatch formation, in sec. 9, T. 50 N., R. 99 W., near Wiley, Big Horn County, Wyoming. It consists of a considerable portion of the carapace and plastron as shown in Plate 36, as well as the humerus and ulna of the right side.

The principal portions missing are all of the peripherals posterior to the third, posterior half of the eighth neural, suprapygal, pygal, seventh and eighth costals of the right side and the eighth of the left side;

[1] Vert. Tert. Form. West., 1884, pp. 129, 132, pl. 18, figs. 26–33.

[2] Fossil Turtles of North America, Pub. Carnegie Institution, 1908, pp. 301, 303, pl. 45, figs. 14, 15, text fig. 380–383.

the plastron lacks the entoplastron and the greater parts of the epiplastra, also much of the lateral borders of the posterior lobe.

The carapace as now preserved is highly arched transversely, the front of the shell descends quite rapidly from the posterior end of the first neural to the nuchal scute. The contour of the anterior end is broadly rounded and without median emargination. It is estimated that when complete the shell had a greatest length of about 135 millimeters. The carapace presents a smooth undulating surface, except for the growth lines of the horny scutes that formerly covered the peripherals and costals. I find similar growth markings on the typical specimens. Immediately outside of the costo-vertebral sulci, the costals are strangely swollen, a feature in which this species resembles *Echmatemys testudinea* (Cope). Cotype No. 4121, U.S.N.M., which has the sixth costal of the left side present, clearly indicates the presence of this swollen "hump." The sulci run in grooves, but where they cross the posterior neurals they are abruptly and deeply impressed, as in some of the typical specimens.

The nuchal is angularly convex transversely. It is 28 millimeters long; 22 millimeters wide on the free border, which is acute. The greatest breadth is 35 millimeters.

The neurals posterior to the first, which is suboval, are all hexagonal, with the widest end forward. The posterior neurals (sixth, seventh, and eighth) are keeled. It will be noted from the table of measurements that all of the neurals except the first are wider than long.

Measurements of neurals, in millimeters.

No.	Length.	Width.
1	17	13
2	12	15
3	13	15
4	13	15
5	12.5	14
6	9	16
7	7.5	14
8	.....	14 *e*

e Estimated.

The median costals are remarkably uniform in the width of the proximal and distal ends. Their upper ends as mentioned previously are conspicuously swollen outside of the deep costo-vertebral sulcus. Except at the swollen portion the costals are comparatively thin. The distal end of the fifth measures but 4 millimeters in thickness. On the inner surface of the first costal the sutural scar for the axillary buttress is 5 millimeters wide and 17 millimeters long.

It extends about halfway up to the midline of the shell. The posterior buttress articulates about equally with the fifth and sixth costals, but extends upward only about halfway to the center of the

shell. The first and second peripherals are relatively thin with acute free edges. The third thickens rapidly toward its posterior border. Its greatest thickness is 10 millimeters; the greatest thickness of the first is 4.5 millimeters. It extends inward from the free border 16 millimeters. The upper surfaces of all have growth lines on the marginals, as shown in figure 1 on plate 36. All flare upward from the costomarginal sulcus, toward the free border.

The nuchal scute is wedge-shaped, the narrow end being forward. On the free border it measures 2.5 millimeters in width; the porterior end, 5 millimeters; length is 7 millimeters.

The vertebral scutes are about as broad as long and rather uniform in size. The sides are nearly parallel, with only a suggestion of being bracket-shaped at the point where the costal sulcus is given off. The principal dimensions of the vertebral scutes present are given in the table:

Measurements of vertebrals, in millimeters.

No.	Length.	Width.
1	32.5	27
2	25	26
3	27	27
4		29

The first marginal is 18 millimeters wide, and extends mesiad 11 millimeters; the second and third, 15 millimeters wide and 10 millimeters high, respectively. The sulci are moderately impressed, no broad and deep as in the posterior peripherals of cotype No. 4061 U.S.N.M.

The plastron has a greatest width at the center of about 80 millimeters. On account of the missing portions of the anterior and posterior lobes its length can not be determined. The angular con cavity of the inferior surface suggests that this specimen was a male

The anterior lobe at its base had a greatest width of 60 millimeters The notched sutural border at the center of the anterior ends of the hyoplastrals shows the missing entoplastron to have been angularly rounded behind. At this point the bone is 6 millimeters thick.

The gulo-humeral sulcus reaches the posterior border of the entoplastron but does not appear to have crossed that bone. In this respect it agrees with the entoplastron of *Emys pachylomus* Cope, which is made a synonym of *E. megaulax* by Hay in his Fossil Turtles of North America (p. 301).

The bridge is 50 millimeters wide. The posterior lobe is 65 millimeters wide at the base and 40 millimeters in length at the center. There is a median V-shaped posterior notch.

The hypoplastrals meet on the midline for 28 millimeters; hypoplastrals for 37 millimeters; xiphiplastrals for 23 millimeters.

The humerals meet on the midline for a distance of 19 millimeters; abdominals for 32 millimeters; femorals for 24 millimeters; and anals for 13 millimeters.

Echmatemys megaulax, as known at this time, in many respects closely resenbles both *E. testudinea* and *E. euthneta*. From the former it appears to be distinguished by the thinness of the shell and the much narrower beveled surface on the superior lateral borders of the hinder lobe immediately posterior to the inguinal buttresses.

In the type of *E. testudinea* the bevelled surface on the mesiad side drops abruptly downward to the level of the plastral surface, whereas in *E. megaulax* it is not only much narrower (as shown by specimen No. 7316, U.S.N.M.), but lies entirely below the level of the median plastral surface, from which it is separated by a very shallow groove. The specimen before me now shows that the swollen costals, outside of the costovertebral sulci, thought by Hay to be distinctive of *E. testudinea*, is a feature common to both species.

While the specimen here considered is like *E. euthenta* in having a thin shell and a narrow beveled surface on the lateral borders of the plastron, it differs in having all neurals except the first wider than long and a greater depression of the sulci.

From *E. cibollensis*, also from the Wasatch, it differs in having the humeral-pectoral sulcus crossing behind the entoplastron, and also in being of much smaller size.

Family TRIONYCHIDÆ.

ASPIDERETES LATUS, new species.

Plate 37.

Type.—No. 8802, U.S.N.M., consists of the carapace, which lacks the nuchal, preneural, and first neural. Collected by Levi Sternberg, 1917.

Type locality.—Sand Creek, Province of Alberta, Canada.

Horizon.—Belly River formation, Upper Cretaceous.

The turtle carapace described below is provisionally referred to the genus *Aspideretes*, as the absence of the nuchal, preneural, and first neural renders a positive genus determination impossible at this time.

Except for the loss of the parts mentioned this specimen is in an excellent state of preservation. Certain peculiarities show it to be an undescribed species, and the name *Aspideretes latus* is here proposed.

The carapace has been flattened by pressure so that its natural transverse convexity has been largely eliminated. The shell is wider than long, the greatest diameter across the third costals being 290 millimeters. It is estimated that the greatest length at the center was about 240 millimeters.

The carapace is subquadrangular in outline, broadly rounded behind with a narrow median notch. The loss of the nuchal does not permit a description of the anterior outline of the shell. The median anterior portions of the first pair of costals are deeply and broadly excavated, as shown in figure 8, indicating that a considerable portion of the nuchal extended well posterior into the disk. The lack of sutural edges along these borders would appear to show that the bony connection of the nuchal with the remainder of the disk was entirely with the preneural, and that its lateral branches were probably free, as in *Aspideretes puercensis*, at the most only overlapping the projecting ribs extending from the first costal plates.

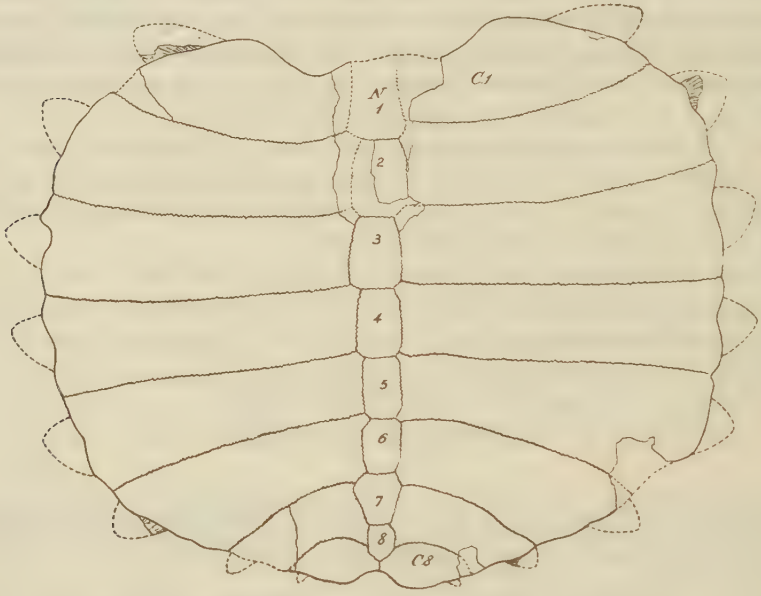


FIG. 8.—CARAPACE OF ASPIDERETES LATUS NEW SPECIES. TYPE. NO. 8802, U.S.N.M. *C. 1, C. 8*, COSTAL BONES ONE AND EIGHT; *N. 1, 2, 3, 4, 5, 6, 7, 8*, NEURAL BONES ONE TO EIGHT. ABOUT ONE-THIRD NATURAL SIZE.

In the complete shell there were eight neurals; the first, however, is missing in the type-specimen. It is the only Trionychid known to the writer to have a full complement of neurals, as usually one and often two posterior neurals are absent; thus six and seven being the usual number of these bones. The eighth neural, though reduced in size, lies partially between the eighth pair of costals and extends nearly to the median posterior border. The second, third, and fourth neurals are hexagonal, longer than wide, with the broad end posterior, as in all Trionychids. The fifth is a paralellogram and only in contact with the fifth pair of costals as in *Aspideretes foveatus* (Leidy). The sixth and seventh are hexagonal with the broad end in front. The

eighth is reduced in size and suboval in form. Their principal dimensions are given in the accompanying table.

Measurements of neurals in millimeters.

Neurals.	Length.	Width.
2	..	23
3	30e	24
4	29	21
5	25	15
6	23	14
7	21	18
8	14	11

e Estimated.

The first costals differ from those of all other members of the genus in being narrower than the second pair of costals at their proximal ends. From the second to the eighth the costals become successively narrower on the proximal end. The eighth pair meet on the midline behind the eighth neural for only 8 millimeters.

The ornamentation of the carapace resembles somewhat that of *Aspideretes splendidus*, consisting of abrupt and sharp-topped ridges which by their union inclose pits and furrows of irregular size and form. They are largest on the middle of the lengths of the costals, extending over nearly the whole surface of the reduced posterior costals. There are usually 4 or 5 of these pits or furrows in a 10-millimeter line. The pits diminish slightly in size along the middle of the shell, but toward the free borders the pits grow smaller, finally disappearing altogether, thus having a smooth band around the border, extending somewhat inward from the beveled surface, especially on the median costals. The scalloped borders of the disk are beveled off from the top side to a sharp edge. The ribs projected beyond the ends of the costals, but their exact extension can not be determined in the type, as all are missing.

The presence of eight neurals, the comparatively narrow and deep median excavation of the anterior end of the disk for the nuchal and the apparently loose articulation of that bone with the first costals, the presence of a full complement of neurals, is an assemblage of characters differing from all described species.

It resembles the other known species of *Aspideretes* from the Judith River, Belly River deposits, in having the shell broader than long and in the general character of the ornamentation of the shell.

EXPLANATION OF PLATES.

PLATE 29.

Carapace of *Neurankylus wyomingensis*, No. 7581, U.S.N.M. Type. Superior view. About one-third natural size.

PLATE 30.

Plastron of *Neurankylus wyomingensis*, No. 7581, U.S.N.M. Type. Ventral view. About one-third natural size.

PLATE 31.

Carapace of *Baëna antiqua* Lambe, No. 8801, U.S.N.M. Superior view. About two-thirds natural size.

PLATE 32.

Plastron of *Baëna antiqua* Lambe, No. 8801, U.S.N.M. Ventral view. About two-thirds natural size.

PLATE 33.

Carapace of *Boremys albertensis*, No. 8803, U.S.N.M. Type. Superior view. About one-half natural size.

PLATE 34.

Plastron of *Boremys albertensis*, No. 8803, U.S.N.M. Type. Ventral view. About one-half natural size.

PLATE 35.

Shell of *Agomphus alabamensis*, No. 8806, U.S.N.M. Type. Viewed from the left side. More than one-half natural size.

PLATE 36.

FIG. 1. Carapace of *Echmatemys megaulax* (Cope), No. 7316, U.S.N.M. Superior view.
2. Plastron of same. Ventral view. Both figures slightly less than natural size.

PLATE 37.

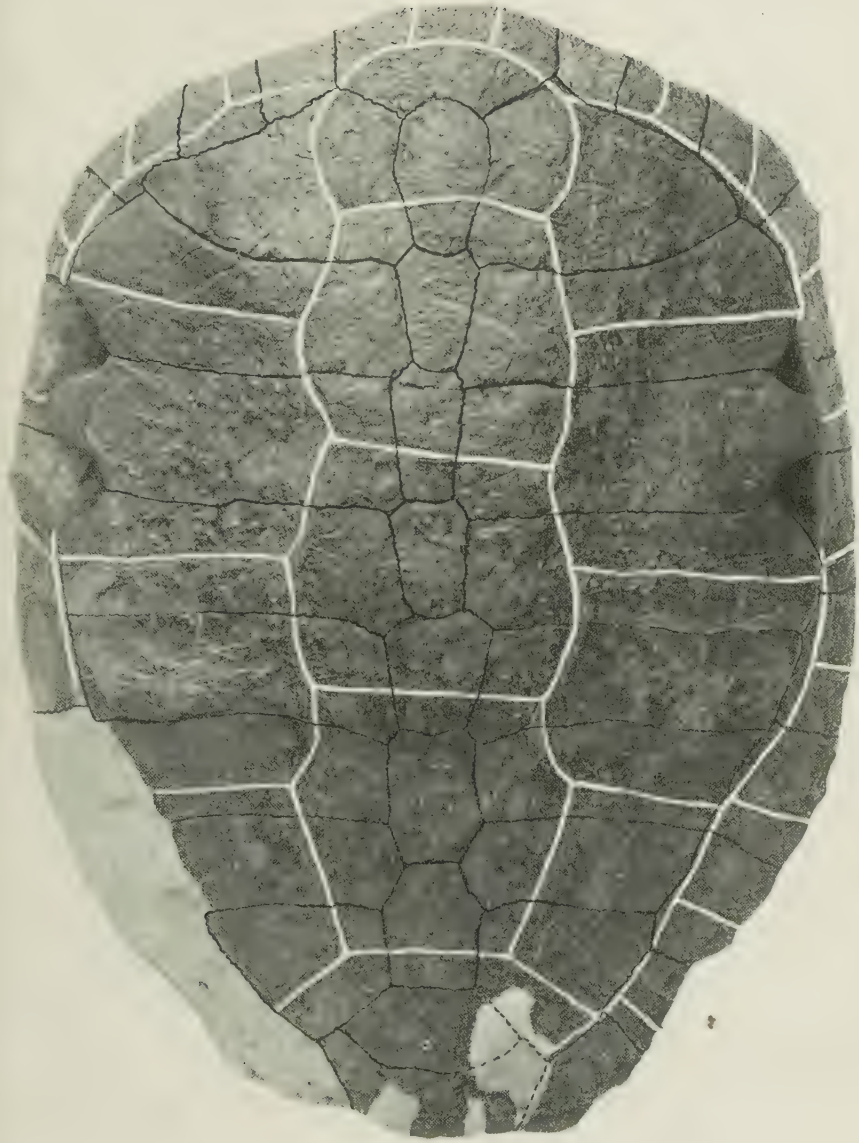
Carapace of *Aspideretes latus*, No. 8802, U.S.N.M. Type. Superior view. More than one-half natural size.

CARAPACE OF NEURANKYLUS WYOMINGENSIS

FOR EXPLANATION OF PLATE SEE PAGE 131

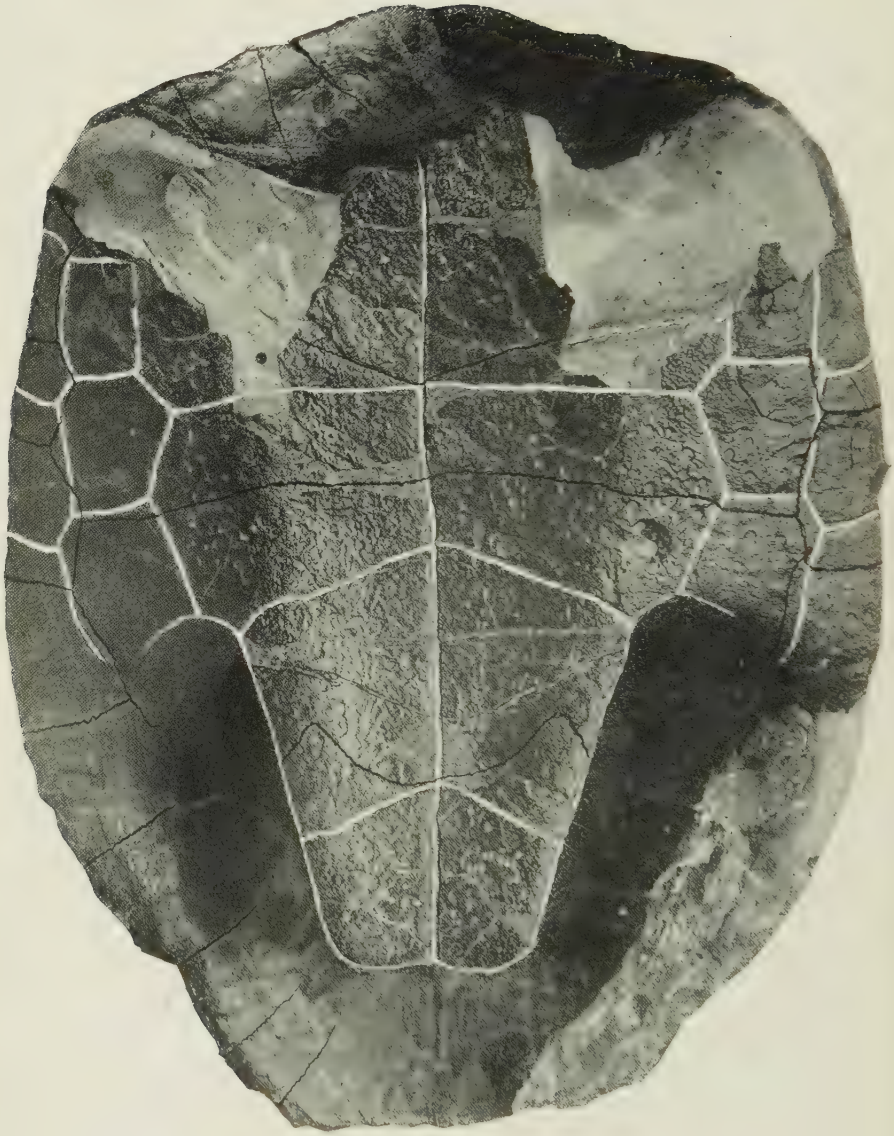
PLASTRON OF NEURANKYLUS WYOMINGENSIS

FOR EXPLANATION OF PLATE SEE PAGE 132



CARAPACE OF BAENA ANTIQUA

FOR EXPLANATION OF PLATE SEE PAGE 132

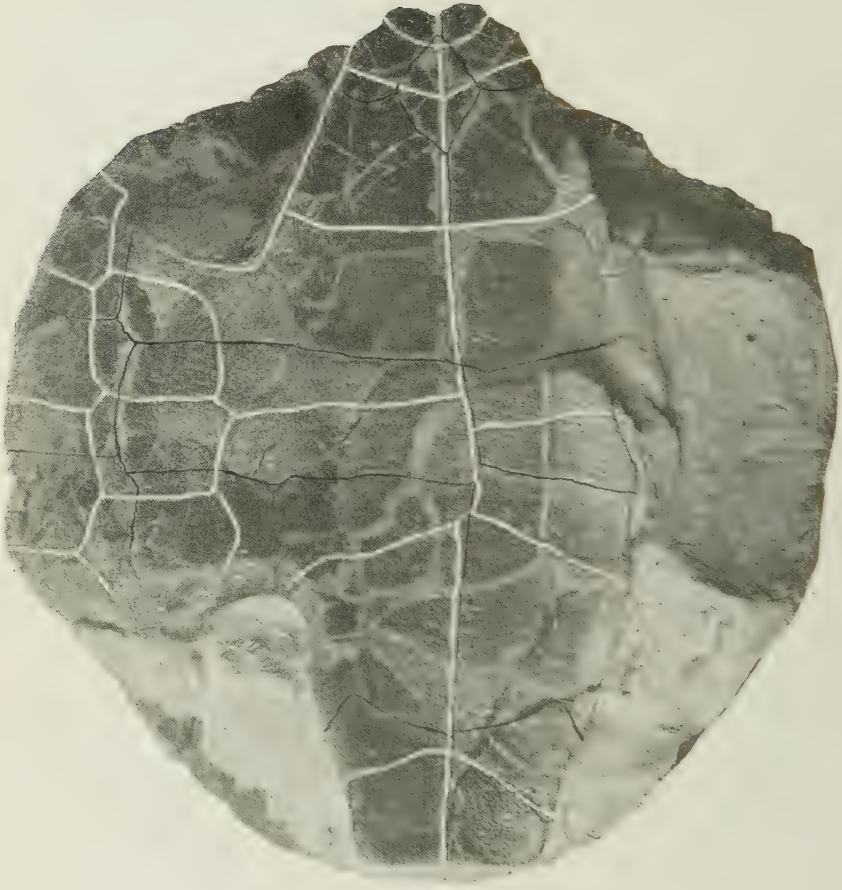


PLASTRON OF BAENA ANTIQUA

FOR EXPLANATION OF PLATE SEE PAGE 132

CARAPACE OF BOREMYS ALBERTENSIS

FOR EXPLANATION OF PLATE SEE PAGE 132



PLASTRON OF BOREMYS ALBERTENSIS

FOR EXPLANATION OF PLATE SEE PAGE 132

SHELL OF AGOMPHUS ALABAMENSIS

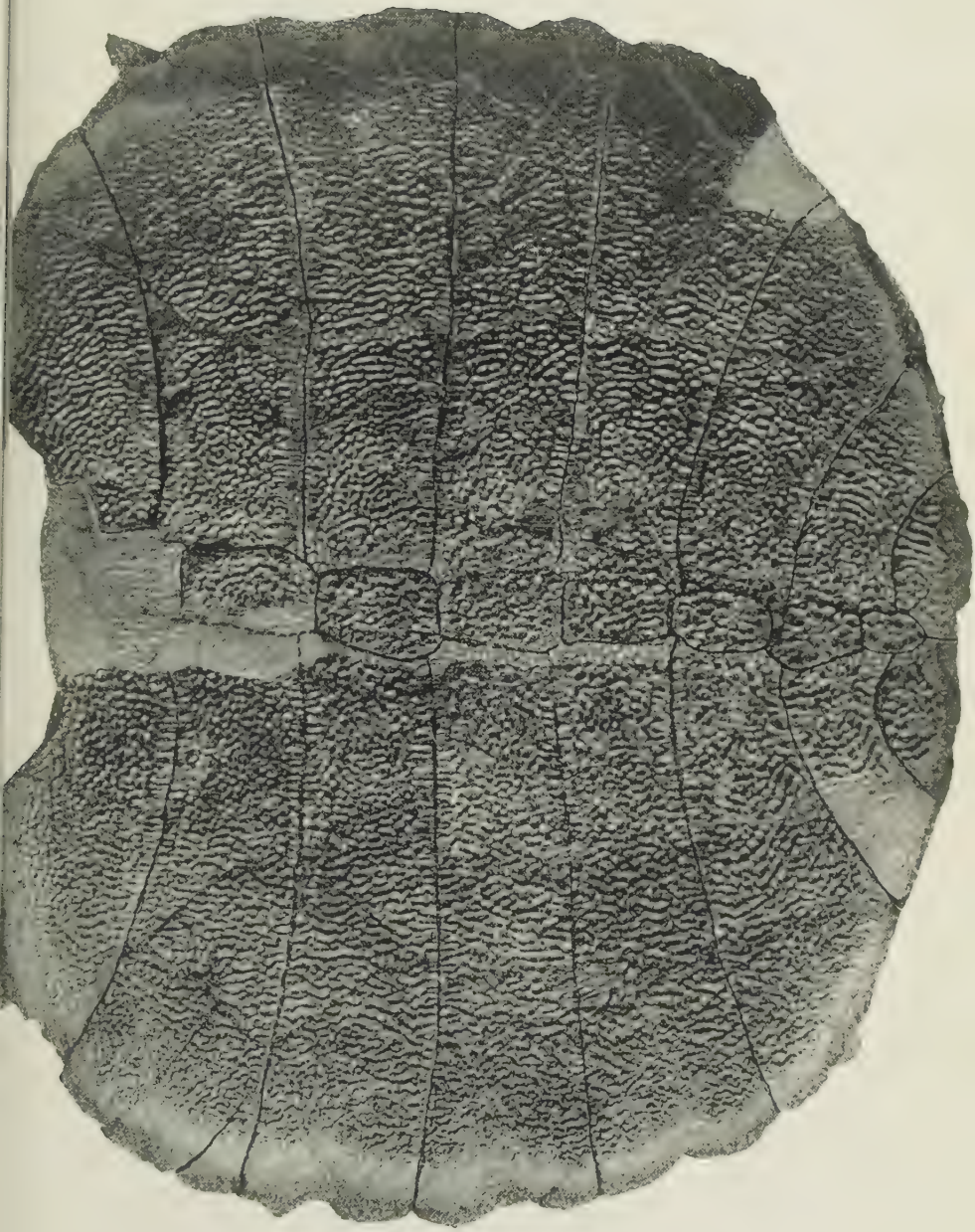
FOR EXPLANATION OF PLATE SEE PAGE 182

1

2

CARAPACE (1) AND PLASTRON (2) OF ECHMATEMYS MEGAULAX

FOR EXPLANATION OF PLATE SEE PAGE 132



CARAPACE OF ASPIDERETES LATUS

FOR EXPLANATION OF PLATE SEE PAGE 132

REVISION OF THE PARASITIC CHALCIDOID FLIES OF THE GENERA HOMALOTYLUS MAYR AND ISODROMUS HOWARD, WITH DESCRIPTIONS OF TWO CLOSELY RELATED GENERA.

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The genus *Homalotylus* was erected by Gustav Mayr [1] for three European species which had been retained previously in *Encyrtus*—namely, *E. flaminius, vinulus,* and *flaviceps*—all described by Dalman in 1820. A few months after Mayr's work appeared, Thomson [2] published his genus *Nobrimus,* based on the same three and a doubtful fourth species, *E. eytelweinii* Ratzeburg, which Mayr had synonymized with *E. flaminius* Dalman. *Nobrimus* has been considered a synonym of *Homalotylus* by subsequent writers, and *Encyrtus flaminius* Dalman is hereby definitely selected as the type, the same species having been selected by Ashmead in 1900 as the type of *Homalotylus.* The genus *Mendozaniella* Brèthes [3] is unquestionably another synonym of *Homalotylus,* as its type *M. mirabilis* Brèthes, agrees throughout in description and figure with the species of *Homalotylus* belonging to the *flaminius* group. The genus also has been redescribed by Girault [4] under the name of *Hemaenasoidea,* the genotype species, *H. oculata,* being closely allied to *Homalotylus vicinus* Silvestri.

Of the eighteen species which have been described or subsequently placed under *Homalotylus* only twelve rightfully belong here as the genus is now restricted. *H. vinulus* (Dalman) and *flaviceps* (Dalman) belong to *Isodromus* Howard; *H. lachni* Ashmead was referred by its author to *Phaenodiscus* in 1887,[5] but in reality belongs to the genus *Microterys* Thomson; *H. similis* Ashmead becomes the type of the new genus, *Anisotylus,* which the writer has ventured to separate from *Homalotylus,* because of several peculiarities; *H. bifasciatus* Ashmead was removed by its author to *Meromyzobia* in 1900; and finally *H. latipes* Girault differs so profoundly in having scattered pin-punctures on the body, foliate hind tibiae, and a three-jointed club, that there is much doubt whether it has any close relationship to *Homalotylus* at all.

[1] Verh. zool.-bot. Ges. Wien, vol. 25, Dec., 1875, or Jan., 1876, pp. 686, 752.
[2] Hymenoptera Scandinavia, vol. 4, 1876, pp. 116, 137.
[3] Anal. Mus. Nac. Buenos Aires, vol. 24, 1913, p. 97, fig. 7.
[4] Annals Entom. Soc. Amer., vol. 9, Sept., 1916, p. 307.
[5] Trans. Amer. Entom. Soc., vol. 14, p. 190.

Of the twelve species remaining in the genus, *H. eytelweinii* (Ratzburg), *orci* Girault and *microgaster* Girault seem to be synonymous with *flaminius* (Dalman), and *H. obscurus* Howard in all probability is a synonym of *H. terminalis* (Say), thus leaving eight valid names of specific or subspecific rank, as the present or subsequent investigations may show. These in the order of their inception are as follows: *H. flaminius* (Dalman), *terminalis* (Say), *scymni* (Shimer), *albitarsus* Gahan, *mirabilis* (Brèthes), *vicinus* Silvestri, *californicus* Girault, and *oculatus* (Girault). In the following pages a substantial addition is made to this list by the characterization of eight new species.

Genus HOMALOTYLUS Mayr.

Homalotylus Mayr, Verh. zool.-bot. Ges. Wien, vol. 25, 1876, pp. 686, 752.—Ashmead, Proc. U. S. Nat. Mus., vol. 22, 1900, pp. 337, 344, 377; Mem. Carnegie Mus., vol. 1, No. 4, 1904, pp. 301, 308.—Schmiedeknecht, Genera Insectorum, Fasc. 97, 1909, pp. 212, 219, 235, 263, 267, pl. 5, figs. 5–6.

Nobrimus Thomson, Hymen. Scand., vol. 4, 1876, pp. 116, 137.

Mendozaniella Brèthes, Anal. Mus. Nac. Buenos Aires, vol. 24, 1913, p. 97, fig. 7.

Hemaenasoidea Girault, Annals Entom. Soc. Amer., vol. 9, 1916, p. 307.

Female.—Head subhemispherical, about as wide as the thorax, usually a little longer than wide, the thickness fronto-occipitally somewhat less than one-half the length; as seen from in front the outline is either nearly circular or broadly oval with the oral margin truncate, as seen from the side the curvature is nearly uniform from the vertex to clypeus although often more abrupt at either end; the occiput nearly flat or but slightly concave above, with the neck inserted near the middle; the vertex narrow at the posterior ocelli, the frons gradually increasing in width anteriorly, so that the anterior corners of the eyes are separated by a space twice or more greater than the width of the vertex; ocelli placed in an acute-angled or at most an equilateral triangle, the posterior pair almost touching the eye-margins; eyes large, narrowly oval, nearly or quite twice as long as wide, posteriorly nearly touching the occipital margin and strongly divergent anteriorly; cheeks short or about equal to one-half the width of the eyes; face short and broad, entirely without antennal scrobes, the antennae inserted rather far apart and close to the clypeal margin, the space between their sockets moderately convex yet never prominently elevated. Scape long and slender, about equal to the length of the head or a little more, the radicle joint about one sixth of the total length, the scape proper often slightly curved on the basal half, the dorsal side convex, the inferior surface flattened and grooved on the apical half or third for the reception of the pedicel, the inner, inferior margin at the apex often lamellately produced, but never more than slightly so; pedicel obconical, about equal to the first and a half or sometimes the whole of the second funicle joint combined; funicle six-jointed, cylindrical, never increas-

ing more than slightly in thickness distad, the joints usually nearly equal in length except that the first one is often a little the longest, the following most often but little or no longer than thick, and rarely more than a half longer than thick; club solid, and strongly obliquely truncate from apex to base through the shrinkage of the softer wall of the inner side (by the rotation of the flagellum the truncation, however, usually appears to be on the underside or even on the upperside), thus producing a very acuminate, conical effect; in at least two species (*affinis* and *brevicauda*) a slight trace of segmentation reappears as an atavistic character, in which case the club is broader across the base, less conical, and truncate only to about the basal third; in length the club nearly or quite equals the last three funicle joints combined. Mandibles rather short and robust, broad at apex and tridentate, the teeth short and rather blunt (*flaminius* and allies), the two on dorsal or inner side separated by a shallow emargination only, or they may be considerably longer and more acute in varying degrees (species of the *vicinus* and *cockerelli* groups), the middle one sometimes a little longer than the other two. Palpi short, the maxillary pair four jointed, with the apical joint a little the longest and slenderest and the basal joint the shortest; the labial pair three jointed with the middle joint considerably shorter than the other two, or sometimes two jointed with the apical joint shorter than the basal.

Thorax rather short and robust, cylindrical, not at all depressed; pronotum short and arcuate, the mesoscutum twice as wide as long; axillae triangular, acutely meeting, their surfaces perfectly flush with the surface of the scutellum; the latter large, well elevated, triangular and rather acute at apex, the sides from base to apex abruptly declivous; propodeum narrow at the middle, gradually widening towards the sides, the spiracles small and oval, situated at the anterior lateral corners. Wings large, rather wide, reaching well beyond the apex of the abdomen; venation reaching about to the middle of the disk, marginal vein somewhat longer than thick; the stigmal slender and moderately long, nearly parallel with margin or at a very acute angle with the submarginal vein, not or but little enlarged at apex although not rarely attenuated towards the base; postmarginal well developed, tapering from a thick base to extreme tenuity at a point about opposite the end of the stigmal vein, sometimes appearing either somewhat shorter or somewhat longer than the stigmal; disk of the wing thickly ciliated, but not uniformly so as to appearance, the basal third of the disk having the cilia transparent, and a large oval area in the middle of the disk beyond the end of the stigmal vein with similar cilia (seen most advantageously in slide mounts of the wing); speculum (or oblique hairless streak) narrow but distinct, running from the base of the stigmal vein obliquely towards the opposite

margin but lost in the area of transparent cilia at about two-thirds of the distance across the disk. Legs, especially the middle and hind pairs, long and for the most part slender, the front and hind femora and the hind tibiae compressed and a little widened, the middle tibiae slender, cylindrical, but rather abruptly enlarged at the apex; front and hind tarsi slender, the joints of the front pair nearly equal, with the first joint but little longer than the following, the first joint of the hind pair about twice as long as any of the following joints, middle tarsi considerably thicker than the other pairs, the first joint nearly as long as the following joints combined, and with a row of fine, short, close set spines on each side beneath, the following joints gradually tapering so that the apical joint is no thicker than the same joint of the front or hind tarsi; middle tibial spur very long, and rather stout, about equal to the first tarsal joint in length; hind tibiae with but one small but distinct apical spur.

Abdomen about two-thirds as long as the thorax, depressed (if not distorted as sometimes happens), as broad as long or even wider, the sides nearly parallel as far as the tactile plates, and from that point bluntly rounded or very obtusely angled to the apex: the first tergite (not counting the propodeum) by far the longest or covering nearly one-half of the dorsal surface, the following one or two segments often concealed by it; the tactile plates situated at about a fifth of the distance from the apex to the base, the vibrissae unusually short and inconspicuous; on the venter the basal tergites nearly meet at the meson, the apical ones diverging towards the apex, leaving only the fifth ventrite plainly visible, the latter reaches to the apex and encloses the ovipositor but is not at all compressed except in distorted specimens that simulate the posture assumed during the process of oviposition; ovipositor in species of the *flaminius* group concealed or nearly so but in species allied to *vicinus* and *cockerelli* it is prominently protruded and slender.

Sculpture of the dorsal surface of the head very finely punctulate, the minute punctures being rounded and separated by slightly elevated interstices; face, frons, and to a less extent the vertex in all but two species (*vicinus* and *oculatus*) with more or less distinct, scattered, small, and shallow pin punctures; upper part of the occiput finely lineolate, either transversely or more or less rimosely or reticulately so in some species; pronotum and mesoscutum very finely scaly-reticulate with scattered setiferous punctures of great minuteness, the pleura with a similar but slightly coarser sculpture, the lines on the greater part of the mesopleura being longitudinally arranged; axillae and scutellum with a sculpture of the same type as that of the frons, but somewhat coarser, the interstices between the punctures more elevated, thus producing a much more opaque effect, and th pin punctures always absent; metapostnotum transversely lineolate

the propodeum nearly smooth; dorsum of the abdomen, especially at the first tergite, reticulately lineolate in varying degrees of coarseness, but always much more coarsely scaly than the mesoscutum.

Pubescence of the head and mesoscutum short and scattered, but rather prominent in the dark-colored species on account of its white color, that of the scutellum, however, often blackish (as in the *flaminius* group); the silvery white pubescence of the metapleura and upper surface of the hind coxae very thick, appressed, and practically concealing the underlying surface.

Coloration more or less metallic, greenish black predominating in the species of the *flaminius* group; in the other species the head and scutellum often orange yellow or orange brown; axillae and scutellum always much more opaque than the scutum; club of antennae always white, and the tegulae white with the apical margin more or less brown or blackish; wings always with a broad smoky band across the middle of the disk, the apex in some species also smoky but to a less degree.

Male.—The two sexes are so similar in almost all details that it is sometimes difficult to distinguish them. In species having an exserted ovipositor the males, of course, are distinguished at a glance, and in the other species they can generally be known by a prominent longitudinal fold along the meson of the venter. In three of the known species (*vicinus*, *africanus*, and *oculatus*) the scape of the male is prominently notched on the upper side just beyond the middle.

Type of genus.—Encyrtus flaminius Dalman. (Selected by Ashmead, 1900.)

The genus on the whole is correctly placed in Ashmead's tables, and for one who is familiar with their shortcomings it is easily identified. However, the term "lenticular" used in couplets 16 and 66 [1] is undoubtedly inaccurate and misleading, as a menisciform shape is meant. As a matter of fact the head of *Homalotylus* is more nearly lenticular than it is in the *Bothriothorax* series of genera (although by no means menisciform), and this discrepancy in the tables probably led Brèthes to erect the genus *Mendozianella*. Schmiedeknecht [2] follows Ashmead in this error.

In Girault's tables [3] *Homalotylus* is impossibly placed, as the club is not three-jointed but distinctly solid in almost all of the species. Both it and *Isodromus* Howard should run to *Isodromoides* Girault (on page 120); the latter genus, however, is apparently only superficially similar to these. Girault also uses the term "lenticular" or "convex-lens-shaped" in several places, but defines his meaning on page 183.[3]

[1] Mem. Carnegie Mus., vol. 1, No. 4, pp. 300, 306.
[2] Genera Insectorum, Fascicule 97.
[3] Mem. Queensland Mus., vol. 4, pp. 120-128.

The species of *Homalotylus* are parasitic in Coccinellid larvae (sometimes issuing from the pupa), and two are known to attack Chrysomelid larvae as well. They are, therefore, of prime economic importance and detrimental on the whole to the interests of agriculture.

The species may be divided into three groups as follows:

1. Ovipositor prominently protruded 2
   Ovipositor not protruded and hardly visible, except in distorted specimens. *Flaminius* group.
2. Head considerably longer than wide, the vertex very narrow, the pin-punctures sometimes absent on the frontovertex ..... *Vicinus* group.
   Head hardly or not at all longer than wide, the vertex comparatively wide, the pin-punctures usually well developed ..... *Cockerelli* group.

FLAMINIUS GROUP.

The forms of *Homalotylus* belonging to this group show a considerable amount of structural variation, within very narrow limits, however, and an even greater degree of colorational variation, thus presenting unusual difficulties in the way of their specific separation. Leaving out of account small variations they seem to have great structural stability, from within the narrow limits of which thay have been unable to depart, and yet the group has great antiquity, as it has become spread over all of the greater land masses of the earth. Specimens from such widely separated regions as Europe, Australia, South Africa, Asia, and North America exhibit only minor structural differences, many of which seem to be more individual than geographic in character. The variation in color although greater in extent seems in some ways even less dependent on locality, yet it must be confessed that some of the North and South American forms present by far the greater range of departure from the normal type of coloration. Leaving out of consideration these extreme American departures from the typical scheme of coloration, the same minor variations may be found in widely separated areas.

On account of this stability in form and to a less extent in color, coupled with a puzzling degree of variability, the writer has labored under great difficulty in reaching any definite conclusion on the specific identity of certain forms, and has been obliged to reverse his opinion several times as the study of the forms progressed. The final conclusion, subject, however, to further revision if necessary, leaves one Old World species and six ostensible American species in the field, since the variation in the material examined seems to that extent discontinuous.

The writer has formed the opinion, however, that there are innumerable local races, probably to a large extent physiological, of several of the species, some of them exhibiting colorational departures from the usual type, others not, and perhaps in most cases breeding true. In some localities there are apparently several of these races,

and it is possible that in such cases more or less interbreeding takes place, although this is not yet proved. Thus at Brownsville, Texas, at least four variations of *H. terminalis* (Say) have been discovered, all apparently from the same host, *Coleomegilla maculata fuscilabris* (Mulsant), and two of which are practically at either extremes of the colorational range of the species.

In this connection it would be well to note that all specimens of the same brood are practically identical in coloration, and this holds true also when the parasites are bred through several generations.

The writer's experience in this connection has not been so extensive as desirable, yet it is of considerable interest. In the summer of 1913 a brood of *H. californicus* Girault was reared at Salt Lake City, Utah, from a larva of *Adalia bipunctata* (Linnaeus), and the parasites were carried through several generations on the same host with the greatest ease. In the spring of 1915 a few specimens of *H. terminalis* (Say), belonging to a dark-colored variety, were collected at Brownsville, Texas, in a small plot of oats where the larvae of *Coleomegilla* had been abundant a short time previously. These were supplied with larvae of *Coleomegilla*, but failed to show any interest in them. Specimens reared a few weeks later from a larva of the same host collected near Brownsville behaved in the same manner and also refused to attack larvae of two or three other species of Coccinellids including *Cycloneda rubripennis* Casey and *Adalia bipunctata* (Linnaeus). This behavior seemed unaccountable, as usually *Homalotylus* females like all other Encyrtids handled by the writer have oviposited in captivity with much readiness when supplied with their customary host, yet it must be admitted that the parasites were not given a complete trial on account of the press of other work. In July of the same year (1915) a brood of *Homalotylus californicus* Girault was reared at Salt Lake City, Utah, from a larva that was considered at the time to belong probably to *Hippodamia convergens* Guérin, and a series of experiments was started with these females, which, although not complete, has more than the usual significance. Unfortunately no larvae of *Hippodamia convergens* were at hand for experimentation, but larvae of the following species were exposed to the parasites under close observation: *Hippodamia parenthesis* (Say), *Hippodamia lecontei* Mulsant, *Hippodamia 5-signata uteana* Casey, *Hippodamia 5-signata ambigua* LeConte (from Oregon stock), *Coccinella 5-notata* Kirby, *Coccinella 9-notata* Herbst, *Coccinella difficilis* Crotch, *Olla abdominalis* (Say) (from Texas stock), and *Naemia seriata* (Melsheimer) (from Texas stock). Of all these possible hosts only *Coccinella 5-notata* and *Coccinella difficilis* proved attractive to the parasites, and the larvae of these two species were immediately parasitized when exposed to the females. The larvae of the other species were either entirely disregarded, or rejected by

the females after being examined. A larva of *Naemia seriata*, however, that had been rejected on July 26 was attacked and parasitized on the following day, after it had been kept over night in a vial with larvae of *Coccinella 5-notata*, in the meantime evidently having absorbed some of the more attractive odor of the latter species. Another *Naemia* larva was rejected again, however, after being kept with larvae of this *Coccinella*.

Although the larvae of *Coccinella 5-notata* and *difficilis* were immediately attacked when exposed to the *Homalotylus*, the results of parastism on the whole suggested the great probability that neither of these species was a customary host. Thus, out of the four larvae of *5-notata* which were parasitized only one produced *Homalotylus*, two transformed into beetles, and one died in the pupal stage and showed no sign of parasitism when dissected. Only two larvae of *difficilis* were used in the experiments, one dying in the larval stage, the other in the pupal stage, without signs of parasitism in either case. On the other hand, the single larva of *Naemia* which was parasitized produced *Homalotylus* in due time, but *Naemia* does not occur in Utah and the species succumbed more because of weak resistance perhaps than because of adaptation to it on the part of the parasite. A similar case was observed at Whittier, California, in the summer of 1912, when the same species of *Homalotylus* was reared from *Cheilomenes sexmaculatus* (Fabricius), an Indian species of Coccinellid, which the writer was attempting to establish in California at that time. Two parasitized larvae of this beetle were found on a walnut tree where the Coccinellids had been liberated previously and on which the larvae of *Olla abdominalis* were also abundant, the latter species probably serving as the usual host for the parasite.

These observations and experiments have led the writer to believe in the existence of physiological races as noted above. *Homalotylus* has been reared also from Chrysomelid larvae on at least two different occasions, once in Europe as recorded by Francis Walker, and once in North America by George Dimmock. In the light of the above experiments it does not seem probable that a *Homalotylus* coming from a Coccinellid host would attack or at least successfully parasitize a Chrysomelid larva, when even closely related species of Coccinellids may be rejected or found resistant to parasitism. The forms parasitizing Chrysomelids therefore are probably extreme physiological races, although in other respects they appear to be identical with the ordinary forms.

Because of the difficulty in deciding about the identity of colorational forms the writer resorted to a study of the male genitalia in the hope of finding useful contributary characters, but without satisfactory results. Although minute differences could be detected they did not seem to present enough constancy among themselves nor any

striking variation from the same parts in obviously distinct species belonging to other groups of *Homalotylus*.

The following key to the species of the *flaminius* group, although based entirely on the female sex, will be found equally useful to separate the males, on account of the close similarity between the sexes.

KEY TO THE SPECIES OF THE FLAMINIUS GROUP.

1. Distal half of funicle and the club white or yellowish white.....4.
   Funicle entirely blackish, except rarely the sixth joint, the club white.
   Head seen from in front noticeably longer than wide.....6.
   Head seen from in front not appreciably longer than wide.....3.
2. Head and thorax greenish black or more rarely bluish black.
   1. *flaminius* (Dalman).
   Head and most of thorax ferruginous or more or less miniacious, the mesoscutum black.....2. *mirabilis* (Brèthes).
3. Head yellowish brown, or if greenish with a bronzy luster.....3. *terminalis* (Say).
   Head dark green or greenish black, with a metallic greenish luster.
   4. *californicus* Girault.
4. Middle and hind tarsi white.....5.
   Middle tarsi yellowish white; the hind tarsi blackish brown.
   5. *mexicanus*, new species.
5. Mesoscutum and abdomen blackish brown; head and rest of body ferruginous; front and middle legs ferruginous, the hind legs dark brown.....6. *albitarsus* Gahan.
   Body brown, the head pale yellowish, the legs paler brown.....7. *scymni* (Shimer).

1. HOMALOTYLUS FLAMINIUS (Dalman).

Plate 38, figs. 2–4.

Encyrtus flaminius Dalman, Svensk. Vet.-Akad. Handl., vol. 41, 1820, p. 340.
Encyrtus eytelweinii Ratzeburg, Ichn. der Forstins., vol. 1, 1844, p. 210.
Encyrtus apicalis Ratzeburg, Ichn. der Forstins., vol. 3, 1848, p. 145 (not Dalman, 1820).
Homalotylus flaminius Mayr, Verh. zool.-bot. Ges. Wien, vol. 25, 1876, p. 753.—Masi, Boll. Portici Lab., vol. 1, 1907, p. 288, fig. 42–43.
Nobrimus flaminius Thomson, Hymen. Scand., vol. 4, 1876, p. 138.
Nobrimus eitelweini Thomson, Hymen. Scand., vol. 4, 1876, p. 139.
Homalotylus orci Girault, New Javanese Hymenoptera, Washington, D. C., Mar., 1917, p. 3.
Homalotylus microgaster Girault, Insec. Insc. Menst., vol. 5, Oct., 1917, p. 134.

Female.—Head subhemispherical, rather thin fronto-occipitally, about one-fifth longer than wide, as seen from the side the curvature nearly uniform from the oral to the vertical margin, thickest at or near the middle, the distance from the lower, inner corners of eyes to the antennal sockets being about equal to the distance from the lower, outer corners of eyes to the occipital margin; eyes moderate in size, elliptical in outline, fully twice as long as wide, strongly converging above so that the vertex is about one-half as wide as the face at the lower corners of eyes; ocelli in an acute-angled triangle, the lateral pair touching the eye-margin and nearly as far removed from the vertical margin as from the anterior ocellus; face hardly

protuberant between the antennal sockets, the rims of the latter flush with the surface of the face. Antennal scape linear with the lower margin slightly expanded as a narrow rim on the apical half, forming a slight groove on the exterior surface for the reception of the pedicel; the latter nearly as long as the first two funicle joints combined; funicle joints decreasing slightly in length distad, the first about one-half longer than thick, rarely but little longer than thick, the sixth as thick as long; club slightly longer than the last three funicle joints combined, hardly thicker and obliquely truncate beneath. Thorax, abdomen, and legs as described under the generic heading; the ovipositor not protruded. Forewing with a broad more densely ciliated cross-band across the middle of the disk, the basal area proximad of the cross-band with weaker, paler cilia, or in large part bare, and the apical part beyond the band moderately thickly ciliated but enclosing between itself and the cross-band an oval spot of much weaker, paler cilia, variable in size, but always well separated from either margin of wing, the speculum narrow but distinct, originating at the base of the stigmal vein and becoming lost at the middle of the disk in the bare area at base of wing. Head microscopically, punctulately shagreened, the punctures roundish, extremely close set and with slightly raised interspaces, the upper part of occuput similarly shagreened but rimosely, transversely striate with very fine raised lines instead of punctulate; face, frons, and vertex to much less degree also provided with shallow, rather small setigerous pin-punctures, which are scattered but rather numerous; pronotum and mesoscutum microscopically, closely reticulate, with numerous scattered, minute, setigerous punctures; axillae and scutellum sculptured like the fronto-vertex, but the microscopic punctures considerably deeper, producing a much more opaque effect, those on the axillae slightly larger, more oval, and transversely arranged; propleura, prepectal plates, tegulae, and anterior half of mesopleura like the scutum, but the reticulations considerably coarser, the posterior half of mesopleura becoming longitudinally striate; metanotum transversely and very finely aciculate, the propodeum nearly smooth; abdomen coarsely, longitudinally reticulate on the sides of the first tergite, transversely and more coarsely reticulate at the middle of the tergite, and becoming smooth on the anterior margin of the segment, the following segments especially the next two with a similar sculpture. Length, 1.21 to 2 mm.

Head dark olive green (R.)[1] with a strong but not brilliant metallic luster, rarely somewhat bluish black, the clypeal region up to the bases of the antennae somewhat brownish yellow; pronotum and mesoscutum greenish or more rarely bluish black with a metallic

[1] An "R." in this and the following descriptions implies that the color in question had been determined after comparison with Ridgway's color plates in Color Standards and Nomenclature, Washington, D. C., 1912.

luster; axillae and scutellum dull, opaque black except when viewed at a strongly oblique angle from the sides or in front when a metallic luster appears; metanotum, propodeum, and abdomen black with a bluish or greenish luster; sides and underparts of thorax usually shining brownish yellow, but not rarely becoming entirely metallic black, more greenish on the propleura and rather strongly bluish on the mesopleura, in the intermediate forms the dark coloration appearing first on the posterior half of the mesopleura; tegulae ivory white with their apical margin black. Antennae black with a slight bluish metallic luster on the scape and pedicel, the funicle duller, often slightly brownish, the sixth joint varying to paler, not infrequently becoming white or yellowish white like the club. Wings with a broad, brownish crossband across the middle, coterminous with the band of darker colored cilia described above, wider on the anterior margin, paler and narrower on the posterior margin, the apical margin of band itself slightly convex and originating at the apex of the stigmal vein. Legs variable, the front and hind tarsi brownish or blackish, the middle tarsi and spur white or yellowish white, except in the typical European form, which has the coloration of the middle and hind tarsi reversed; in the paler forms the front coxae and femora and the middle femora are yellowish brown, the remaining parts, except the tarsi as noted above, dark brown or blackish, often with a metallic luster on middle coxae and the hind femora; in the darker forms the legs become entirely black or blackish with a more or less distinct metallic luster, with the exception of the white middle tarsi and spurs. Vestiture of head consisting of white, scattered subappressed, short hairs most numerous on the face and especially around the antennal sockets; pronotum and mesoscutum with a similar white pubescence, the axillae and scutellum with a darker colored pubescence; metapleura densely white pubescent, the coxae of middle and hind legs similarly but considerably less densely pubescent.

Male.—Hardly differs from female, but the band on the wings is not so deeply stained and the size averages smaller. Length, 1.45 to 1.83 mm.

The following material all seems referable to *flaminius:*

Series 1. One female reared from material of *Pseudococcus citri* (Risso), probably issuing from a larva of *Exochomus quadripustulatus* (Linnaeus), Palermo, Sicily, June, 1914 (H. L. Viereck), California State Insectary No. 727B. Head metallic olive-green (R.), the upper parts of thorax and the abdomen black, the pronotum and mesoscutum with a greenish luster, the metanotum, propodeum, and abdomen with a slight bluish luster; oral margin of face, underparts of thorax and middle femora ochraceous tawny (R.); the front and middle coxae similar beneath, but metallic bluish above, the front femora

brownish, the rest of front legs and the hind legs brownish black with a slight bluish luster on the hind coxae and femora, the middle tibiae and spur dark brown, and middle tarsi white above but blackish beneath, the last two joints brownish even above. First funicle joint slightly longer than thick, the following joints subequal and about as long as thick; postmarginal vein about a fifth longer than the stigmal. Length, 1.72 mm.

Series 2. One female reared from material of *Saissetia oleae* (Bernard), actual host unknown, Cape Town, South Africa, March 15, 1907 (C. P. Lounsbury). Head invisible green (R.) with a metallic slightly bluish luster, pronotum and mesoscutum shining black, with a bluish green luster, axillae and scutellum opaque blackish, rest of thorax and the abdomen metallic blue-black; legs brownish black; the middle tibiae, front and hind tarsi and last two joints of middle tarsi more brownish; the coxae, femora, and hind tibiae with a bluish luster, the spur of middle tibiae and the first three joints of middle tarsi yellowish white. First funicle joint about a fourth longer than thick, the following joints gradually shortening, the sixth as thick as long; postmarginal vein slightly longer than the stigmal. Length, 2 mm.

Series 3. One female, Swatow, China (A. Koebele). Colored like the Cape Town female, but the head slightly more bluish in luster, the notum slightly more greenish, the mesopleura not as deeply blue-black, the middle femora with apical half on outer surface brownish yellow, only the last joint of middle tarsi brownish black and the last funicle joint brownish. First funicle joint about a sixth longer than thick and no longer than the second, the last two funicle joints no longer than third; the postmarginal vein a little shorter than the stigmal. Length, 1.85 mm.

Series 4. Eight females, two males, China (A. Koebele), Koebele's No. 1200. Head metallic olive green, the notum greenish black, otherwise like the Swatow specimen, but the legs slightly more brownish with a less distinct bluish luster, the middle femora with a narrow yellowish or whitish annulus near the base, and the funicle of antennae more brownish, the last joint becoming yellowish at apex. First funicle joint nearly twice as long as thick, distinctly longer than the second, the following joints shortening but the sixth still slightly longer than thick; the postmarginal vein a little shorter than the stigmal. Length of female, 1.94 to 1.98 mm.; length of male, 1.83 mm.

Series 5. One male, China (A. Koebele), Koebele's No. 1146. Head nearly sepia (R.) but darker with very little luster, the clypeal margin and a transverse spot above antennal sockets and between the lower corners of eyes cinnamon buff (R.), otherwise much like the preceding series except that the underparts of thorax, the abdomen, and legs are more brownish with but little or no bluish luster. First

funicle joint about a fourth longer than thick, following joints all shorter except the fourth, the sixth no longer than thick; the postmarginal vein nearly as long as the stigmal. Length, 1.45 mm.

Series 6. Four females, one male reared from larvae of *Coccinella repanda* Thunberg, Brisbane, Queensland, Australia, September, 1915 (J. C. Bridwell). Colored like series 4 (Koebele's No. 1200), but the head darker green, the funicle blackish except the last joint, which is brownish, and the middle femora a little darker brown. First funicle joint about a fourth longer than thick and a little longer than the second, the last four funicle joints about as long as thick; postmarginal vein slightly shorter than the stigmal. Length of female, 1.53 to 1.82 mm.; length of male, 1.49 mm.

Series 7. One female, one male reared from larva of *Coccinella kingi* MacLeay, Australia (A. Koebele), Koebele's No. 20. Head slightly bluish black with a weak luster, the postorbital region more greenish; notum of thorax dark greenish black, the underparts nearly bister (R.) with the posterior part of mesopleura nearly bluish black; abdomen bluish black; legs concolorous with pleura, the front femora, middle coxae and femora paler or about snuff brown (R.), the front coxae with a purplish luster beneath, middle tarsi except the last joint and the tibial spur yellowish white; scape bluish black, the pedicel and funicle brownish, the club yellowish white. First funicle joint a half longer than thick, the following joints gradually shortening, the sixth about as long as thick; postmarginal vein a little shorter than the stigmal. Length of female, 1.83 mm.; length of male, 1.67 mm.

Series 8. Two females reared from larva of *Verania frenata* (Erichson), Australia (A. Koebele), Koebele's No. 4. Colored practically as in the preceding series. Funicle joints all about equal and as long as thick, except that in one specimen the first joint seems a trifle longer than thick; postmarginal vein nearly as long as the stigmal. Length, 1.21 to 1.24 mm.

Series 9. One female, one male, reared from larvae of *Orcus australasiae* (Boisduval), Australia (A. Koebele), Koebele's No. 2. Colored very nearly as in series 4 (Koebele's No. 1200), but the sixth funicle joint entirely yellowish white and the middle femora a little more brownish. First funicle joint nearly a half longer than thick, the following joints shortening, the sixth about as long as thick; postmarginal vein a little shorter than the stigmal. Length of female, 1.89; length of male, 1.63 mm.

Series 10. Four females, one male reared from larvae of *Orcus chalybeus* (Boisduval), Australia (A. Koebele), Koebele's No. 1. One female like the preceding series, the rest similar but the underparts of thorax varying to cinnamon brown (R.), the middle femora

about buckthorn brown (R.), the middle tibiae a little darker, and the rest of the legs except the middle tarsi and spur brownish black with a slight bluish luster on the coxae. First funicle joint about a fourth longer than thick, the following joints about as long as thick; postmarginal vein a little shorter than the stigmal. Length of female, 1.74 to 1.88; length of male, 1.51 mm.

Series 11. Three females, one male reared from an *Orcus* species (the larval remains mounted with the parasites seem identical with those labeled *O. australasiae* under Koebele's No. 2), Australia (A. Koebele). Like the preceding series except that the underparts of the thorax and the front and middle coxae and femora are ochraceous tawny (R.), the middle tibiae cinnamon brown (R.), the front tibiae and tarsi a little darker, the hind legs blackish brown, and all the coxae with bluish luster; but in two of the females the front legs, except the coxae and underside of femora, and the middle tibiae are concolorous with the hind legs. First two funicle joints a little longer than thick, the following joints about as long as thick; the postmarginal vein about as long as the stigmal. Length of female, 1.77 to 1.86; length of male, 1.63 mm.

Series 12. Two females, two males reared from *Orcus nummularis* (Boisduval), Australia (A. Koebele), Koebele's No. 47. Practically identical with the darker specimens of the preceding series. Length of female, 1.60 to 1.73; length of male, 1.55 mm.

Series 13. Two females, one male reared (at Honolulu, Hawaii) from larva of *Orcus lafertei* Mulsant, Bundaberg, Queensland, December 16, 1904 (A. Koebele and R. C. L. Perkins). Much like the preceding series, but the coxae are more bluish metallic and the mesoplura have a bluish luster. First two funicle joints about a fourth longer than thick, the following joints gradually shortening, the sixth about as long as thick; the postmarginal vein nearly as long as the stigmal. Length of female, 1.83 to 1.93; length of male, 1.76 mm.

Series 14. Two females (cotypes of *H. microgaster* Girault), Australia (A. Koebele). Practically identical with series 9. Length, 1.60 mm.

Series 15. Two females (cotypes of *H. orci* Girault) reared from larva of *Orcus janthinus* Mulsant, Salatiga, Java. Colored much as in the preceding series, but the sixth funicle joint blackish. The first funicle joint about a half longer than thick, the following joints a little shorter but longer than thick; postmarginal vein about a third shorter than the stigmal.

In all of the Australian series the head is slightly longer compared with the width, the scape narrower than usual, much as in *terminalis* of North America, and the pubescence of the face seems slightly longer and more abundant.

Unfortunately the writer has been able to examine only one specimen of *flaminius* from Europe, so that the identity of *eytelweinii* (Ratzeburg) could not be investigated fully. Obviously the two forms are much alike, *flaminius* being described as having the middle tarsi black, the hind tarsi and middle tibial spur white, and *eytelweinii* as having the discoloration of the tarsi just reversed. Mayr considered them to be forms of one species, and apparently had examined intermediate specimens. The specimen in the hands of the writer may also be considered intermediate since the hind tarsi are black, the middle pair almost entirely blackish underneath, and the tibial spur dark brown or in part blackish. Nevertheless no such variation in the color of the tarsi has been observed in specimens from other parts of the world, the hind tarsi being uniformly dark and the middle pair white or pale yellowish in all specimens examined from such remotely separated regions as South Africa, China, and Australia.

Girault's species *orci* and *microgaster* can not be separated from *flaminius*, as they are based on too variable characters. The comparative lengths of pedicel and first two funicle joints, of the stigmal and postmarginal veins, and the slight variations in color noted above can not be relied upon to distinguish species in this group. In general it may be said that in very small specimens the first funicle joint is usually no longer than thick, and becomes gradually longer with increase in size.

Types.—Cat. No. 20674 (of *microgaster* Girault) and 20655 (of *orci* Girault), U.S.N.M.

Table of measurements of flaminius.

Series.	Locality.	Collector.	Length of body.	Width of mesoscutum.	Length of head.	Width of head.	Width of vertex.	Length of antenna.	Length of forewing.	Width of forewing.
			mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
1	Palermo, Sicily	Viereck	1.72	0.63	0.60	0.55	0.115	1.32	1.54	0.58
2	Cape Town, South Africa.	Lounsbury	2.00	.69	.68	.62	.126	1.57	1.84	.71
3	Swatow, China	Koebele	1.83	.64	.64	.59	.115	1.54	1.82	.70
4	China	do	1.94	.70	.69	.60	.136	1.62	1.84	.71
6	Brisbane, Queensland.	Bridwell	1.82	.67	.68	.60	.141	1.45	1.78	.66
7	Australia	Koebele	1.83	.66	.67	.61	.136	1.49	1.78	.66
8	do	do	1.21	.47	.48	.43	.103	.98	1.25	.47
9	do	do	1.89	.63	.68	.56	.122	1.45	1.73	.66
12	do	do	1.61	.58	.60	.51	.103	1.27	1.45	.56
13	Bundaberg, Queensland.	Koebele and Perkins.	1.83	.64	.67	.57	.122	1.40	1.67	.63

2. HOMALOTYLUS MIRABILIS (Brèthes).

Mendozaniella mirabilis BRÈTHES, Anal. Mus. Nac. Buenos Aires, vol. 24, May, 1913, p. 98, fig. 7.

This species is known to the writer only by description. In coloration it recalls certain forms of *terminalis* of North America, such as

series 9, described below, but the head is said to be one-sixth longer than wide, which would ally it more with the Old World forms of *flaminius*. It is recorded from Mendoza, Argentina.

3. HOMALOTYLUS TERMINALIS (Say).

Serlion terminalis SAY, Maclur. Lyc. Phil., vol. 2, 1828, p. 80.
Scelio terminalis CRESSON, Syn. Hym. No. Amer., 1887, p. 248.
Homalotylus terminalis ASHMEAD, Proc. U. S. Nat. Mus., vol. 22, 1900, p. 378.
Homalotylus obscurus HOWARD, Bull. 5 (Old Series), Bur. Ent., U. S. Dept. Agric., 1885, p. 22.

Female.—In structural characters similar to *flaminius*, but the head averages slightly wider as compared with the length, as seen from the side a little thicker or fully as thick on the lower half, the space between the lower corners of eyes and the antennal sockets usually considerably less than the space between the lower, outer corners of eyes and the occipital margin. Sculpture and pubescence practically as in *flaminius*. Length, 1.33 to 2 mm.

Head and underparts of thorax brownish yellow, the head usually with a bronzy, more rarely with a greenish luster, the mesopleura often suffused with brown and with a metallic somewhat bluish luster; notum of thorax and the abdomen black, the scutum with a distinct greenish luster, the axillae and scutellum dull except when viewed at a very oblique angle from in front, the metanotum, propodeum, and abdomen usually with a bluish luster; or in paler variations the brownish yellow coloration may extend over all parts except the hind border of the pronotum, most of the mesoscutum and dorsum of abdomen; tegulae white, the posterior half brown or blackish, or in some cases nearly entirely white. Antennae dark brown or black, the club yellowish white. Legs variable, in darker specimens mostly dark brown or blackish with the middle femora brownish yellow, the tibial spur and middle tarsi yellowish white; in paler specimens only the hind tibiae and tarsi brown or blackish, and the front tibiae and tarsi usually pale brown. Wings banded practically as in *flaminius*.

Male.—Similar to the female, but with the wing markings less distinct. Length, 1.14 to 1.81 mm.

The following material has been examined:

Series 1. Two females (cotypes of *H. obscurus* Howard) reared from Coccinelline larvae, probably *Cycloneda*, Centerville, Florida, July 24 (H. G. Hubbard), Hubbard's No. 46, Insectary No. 2308. Head and underparts of thorax ochraceous orange (R.), the frontovertex and face with a weak bronzy luster, the vertex suffused with brown, the postorbital region with a greenish luster; notum of thorax black with a greenish luster, the scutellum more brownish, the lateral margins of pronotum and mesoscutum like underparts; abdomen rather bluish black with the base brownish, the venter about antique brown (R.) with a bronzy luster; antennae except club dark brown;

legs ochraceous orange, the front and middle coxae somewhat brownish, the middle tibiae pale brown especially distad, the front and hind tibiae and tarsi rather dark brown, the spur and middle tarsi yellowish white. First funicle joint about a third longer again than thick, the following joints gradually shortening, the sixth no longer than wide; the postmarginal vein slightly shorter than the stigmal. Length, 1.77 to 1.96 mm.

Series 2. Six females reared from a Coccinelline larva, Crescent City, Florida, May 25 (H. G. Hubbard), Hubbard's No. 157*b*. Similar to the preceding series, but the yellowish parts more suffused with brownish, the metallic luster stronger and present on the mesopleura, the notum entirely black, the venter of abdomen bronzy brownish black; legs darker, the coxae pale brownish with a purplish luster on the front pair, the middle tibiae brown, the front and hind femora a little darker brown, the front and hind tibiae and tarsi blackish brown. Length, 1.70 to 2 mm.

Series 3. Six females, one male reared from a *Cycloneda* larva, Lakeland, Florida (G. G. Ainslie), Webster No. 5252 I. Head about raw sienna (R.) with a strong bronzy luster, the dorsal orbits of eyes and the vertex metallic dark vinaceous purple (R.); propleura like the face, the mesopleura shining, slightly metallic antique brown (R.); the venter bronzy bluish black; antennae black, except the club; legs brownish black, the front coxae with a purplish luster, the front femora somewhat yellowish brown, the middle femora about raw sienna, with a narrow annulus of purer yellow near the base. Otherwise like series 2, except that the first funicle joint is about a fourth longer than thick. Length of female, 1.67 to 1.82; length of male, 1.63 mm.

Series 4. Four females, two males reared from a Coccinelline larva, Cayamas, Cuba (E. A. Schwarz). Head with a strong green luster largely concealing the yellowish brown ground color except on the face; antennae, thorax, and legs as in series 3, except that the luster of the mesopleura is more bluish, the front and middle coxae with a strong purplish luster, the front and middle femora a little more yellowish, the latter with the annulus near the base indistinct, the tegulae almost entirely white, with a faint brownish spot near the apical inner corner; venter of abdomen about raw umber (R.) or more antique brown (R.) toward the base, and with a bronzy luster. First funicle joint about a fourth longer than thick; the postmarginal vein nearly as long as the stigmal. Length of female, 1.57 to 1.64; length of male, 1.25 to 1.40 mm.

Series 5. Thirty-eight females, 29 males reared from larvae of *Coleomegilla* and *Cycloneda*, Santiago de las Vegas, Cuba (George Dimmock), Dimmock Nos. 2226, 2230, 2235, and 2236. Practically the same as the preceding series, some of the specimens being a

little darker, with more green on the frontovertex, the front femora brownish, and the venter of abdomen more nearly black. The males in both series generally paler, with the yellowish brown ground color of head more evident, and the middle femora more yellowish, but the venter of abdomen darker or blackish. Length of female, 1.33 to 1.79; length of male, 1.14 to 1.48 mm.

Series 6. Eight females, six males reared from larva of *Coleomegilla* or collected on rubbish among oats, Brownsville, Texas, March to April, 1914 and 1915 (R. A. Vickery and P. H. Timberlake). Similar to series 3, but the head with a strong bronzy yellowish to distinctly greenish luster, strongest on the vertex; the underparts of thorax a little brighter or generally more nearly raw sienna (R.) and usually without a metallic luster, although shiny; the venter of abdomen brownish black with a bronzy or bluish luster; front and middle femora concolorous with the pleura, the middle pair without a basal annulus, front and middle coxae brownish with a purplish luster, and the last two joints of middle tarsi blackish instead of the apical one only. First funicle joint about a third longer than thick; the postmarginal vein about three-fourths as long as the stigmal. Length of female, 1.58 to 1.96; length of male, 1.40 to 1.81 mm.

Series 7. Two females reared from a *Coleomegilla* larva, Brownsville, Texas, June 10, 1915 (M. M. High). Like the preceding series but brighter in color, the head and underparts of thorax raw sienna (R.) with a slight greenish luster on the vertex only; venter of abdomen antique brown (R.), suffused with raw umber (R.) medially and toward the base; the front coxae and femora concolorous with the pleura, the middle femora concolorous and with a pale yellowish annulus near the base; the middle and hind coxae and hind femora about antique brown. Postmarginal vein about as long as the stigmal. Length, 1.90 to 1.95 mm.

Series 8. Three females, one male reared from a *Coleomegilla* larva, Brownsville, Texas, August 12, 1912 (E. G. Smyth), Webster No. 6422. Similar to series 1, but the frontovertex with a weak greenish luster, the notum of thorax blacker, with the greenish luster more distinct, the underparts of thorax and of abdomen raw siennna (R.) somewhat more brownish on the venter, the dorsum of abdomen bluish black, the base not paler but the apex yellowish brown, and the antennae and hind tibiae blacker. Length of female, 1.64 to 1.73; length of male, 1.40 mm.

Series 9. Seven females, one male reared from a *Coleomegilla* larva, Brownsville, Texas, July 24, 1912 (E. G. Smyth), Webster No. 6422. Head Kaiser brown (R.) but more yellowish on the occiput, the vertex slightly bronzy metallic; the underparts of the thorax and abdomen raw sienna (R.), shining but hardly metallic; the most of pronotum, the sides of mesoscutum and posterior margin except

medially, the axillae and scutellum about antique brown (R.) with a bronzy luster; the collar of pronotum except the sides and the rest of the mesoscutum blackish with a green luster; the metanotum, propodeum and dorsum of abdomen black with a bluish or in part greenish luster, the apical tergite of the abdomen concolorous with the venter; legs as in series 1; the antennae similar, but the scape yellowish brown on the inner side of the basal half. First funicle joint about a third longer than thick; the postmarginal vein nearly a third shorter than the stigmal. Length of female, 1.63 to 1.75; length of male, 1.41 mm.

Series 10. One male reared from larva of *Anatis quindecimpunctata* (Olivier), Reading, Pennsylvania, July 29, 1886 (F. G. Dwight), Insectary No. 457*o*. Head and underparts of thorax raw sienna (R.), the vertex and occiput considerably darker, and a distinct greenish luster present on the frontovertex and postorbital region; the pronotum and mesonotum brownish black with a green luster, the declivous sides of the scutellum brownish yellow; metanotum and abdomen black with a bluish luster; antennae except club dark brown; legs concolorous with underparts, the hind coxae brown with a purplish luster, the hind tibiae and tarsi brown. First funicle joint about a fourth longer than thick; the postmarginal vein about as long as the stigmal. Length, 1.67 mm.

Say's brief description of *terminalis* applies only to *obscurus* Howard, as the characters, "head yellowish, antennae blackish, terminal joint white" effectually eliminate all other North American species or forms belonging to this group. The species seems to be fairly distinct from *flominius* in the shape of the head, although merging with it in coloration through the subspecies *californicus* Girault. This considerably greater range in coloration of *terminalis* is characteristic of many North American Hymenoptera as compared with the corresponding species or genera of the Old World.

Type.—Cat No. 2648, U.S.N.M. of *obscurus* Howard).

Table of measurements of terminalis.

Series.	Locality.	Collector.	Length of body.	Width of mesoscutum.	Length of head.	Width of head.	Width of vertex.	Length of antenna.	Length of forewing.	Width of forewing.
			mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
1	Centerville, Florida.	Hubbard....	1.96	0.65	0.63	0.62	0.132	1.47	1.73	0.62
2	Crescent City, Florida.	.....do.....	1.70	.63	.63	.58	.122	1.45	1.69	.61
3	Lakeland, Florida...	Ainslie.....	1.81	.66	.66	.60	.130	1.44	1.70	.61
4	Cayamas, Cuba.....	Schwarz.....	1.64	.61	.61	.55	.120	1.34	1.56	.59
5	Santiago de las Vegas, Cuba.	Dimmock...	1.79	.61	.61	.57	.122	1.42	1.63	.61
6	Brownsville, Texas.	Timberlake.	1.73	.62	.63	.57	.125	1.42	1.78	.69
7	.....do.....	High.....	1.90	.63	.64	.59	.130	1.43	1.68	.62
8	.....do.....	Smyth.....	1.68	.55	.58	.54	.115	1.30	1.51	.56
9	.....do.....	.....do.....	1.72	.60	.60	.56	.127	1.34	1.53	.58

4. HOMALOTYLUS TERMINALIS CALIFORNICUS Girault.

Plate 38, fig. 1.

Homalotylus obscurus californicus GIRAULT, Ann. Entom. Soc. Amer., vol. 8, Oct., 1915, p. 274.

Homalotylus terminalis DIMMOCK, Proc. Entom. Soc. Wash., vol. 4, Mar., 1898, p. 149.—ASHMEAD (part), Proc. U. S. Nat. Mus., vol. 22, June, 1900, p. 378.

Female.—In structural characters, sculpture, and pubescence agreeing throughout with *terminalis* (Say), except that the head averages still wider as compared with the length and the antennal scape is slightly wider. Length, 1.28 to 2.26 mm.

Coloration as in *flaminius* (Dalman) and undergoing the same variations, except that the tibial spur and middle tarsi are always yellowish white, the hind tarsi always brown or blackish, and the luster apparently never bluish on the head and notum.

Male.—Like the female, except that the markings on the wings are paler and the size averages smaller. Length, 1.38 to 2.15 mm.

The following material has been examined:

Series 1. Sixteen females, two males (including four female cotypes) reared from a larva and pupa of *Cheilomenes sexmaculata* (Fabricius) (an oriental Coccinellid which was liberated in considerable numbers during 1912 in California), Whittier, California, July 12, 1912 (P. H. Timberlake). Head deep slate olive (R.) with a metallic luster, the oral margin brownish yellow; pronotum and mesonotum black with a greenish luster, underparts of thorax antique brown (R.), suffused with raw umber (R.) and with a bluish or purplish luster, especially on the posterior half of the mesopleura; antennae black, the scape slightly bluish metallic, the club and more or less of the sixth funicle joint in most of the specimens yellowish white; front and hind legs and middle coxae mostly brownish black with a bluish or purplish luster, especially on the coxae, the front femora considerably browner; middle femora about raw sienna (R.) and with a pale yellowish annulus near the base; middle tibiae dark brown, the spur and the middle tarsi except the last two joints yellowish white. Funicle unusually short, the joints subequal, the first joint in most of the specimens no longer than thick; the postmarginal vein about a fourth shorter than the stigmal. Length of female, 1.28 to 1.57; length of male, 1.38 mm.

Series 2. Six females, two males reared from larvae of *Adalia bipunctata* (Linnæus), Salt Lake City, Utah, August 17 to September 13, 1913 (P. H. Timberlake). Similar to the preceding series, but the head somewhat brighter green, the underparts of thorax purer antique brown (R.), being darker and metallic only on the posterior margin of the mesopleura; the last funicle joint slightly more brownish than the other joints, but not whitish; middle femora more

antique brown and without an annulus at the base, the front femora nearly concolorous with the middle pair, but darker on the inner surface with a purplish luster, the hind femora not so black or about concolorous with the middle tibiae. First funicle joint about a third longer than thick, the following joints shortening, so that the sixth is no longer than thick; the postmarginal vein as in the preceding series. Length of female, 1.57 to 1.89; length of male, 1.61 to 1.76 mm.

Series 3. Four males reared from larva of *Coccinella quinquenotata* Kirby, Salt Lake City, Utah, August 19, 1912 (P. H. Timberlake). Like the preceding series, but the last funicle joint is pale brownish, the middle femora more raw sienna (R.), the hind femora blacker, and the fourth joint of middle tarsi nearly white. First funicle joint but slightly longer than thick. Length, 1.40 to 1.50 mm.

Series 4. One female, Salt Lake City, Utah (C. N. Ainslie), Webster No. 5595. Coloration practically as in series 2, but the first funicle joint is only slightly longer than thick and the postmarginal vein is nearly as long as the stigmal. Length, 2.09 mm.

Series 5. Six females, two males reared from larvae of *Coccinella novemnotata* Herbst, Arlington, Massachusetts, August, 1885 (George Dimmock), Dimmock's No. 731c. Similar to series 2, but the oral margin of face and underparts of thorax slightly brighter or more nearly raw sienna (R.) suffused with antique brown (R.) and slightly metallic; abdomen with a stronger bluish green luster, still more greenish on the venter; the last funicle joint of male partly whitish; the front and middle femora raw sienna, the middle tibiae and hind legs browner, and only the last joint of middle tarsi blackish. First funicle joint nearly a half longer again than thick; the postmarginal vein nearly as long as the stigmal. Length of female, 1.66 to 2.03; length of male, 1.77 mm.

Series 6. Three females reared from larva of *Disonycha* species on willow, Springfield, Massachusetts (George Dimmock), Dimmock's No. 2206. Nearly identical with the preceding series, but the underparts of thorax darker or more antique brown (R.), the luster of mesopleura a little more distinct and the hind legs blacker. The postmarginal vein about a fourth shorter than the stigmal. Length, 1.99 to 2.06 mm.

Series 7. Three females, one male reared from a Coccinelline larva, probably Indiana or Ohio (Herbert Osborn). Like series 5 but not so dark, the raw sienna on oral margin extending upward on face above antennal sockets and with a bronzy luster; the underparts of thorax, front and middle coxae, and femora raw sienna (R.); the rest of legs except tibial spur and middle tarsi dark brown, the middle tibiae and hind femora more yellowish brown; last funicle joint in

one female partly whitish, and in the male yellowish white. First funicle joint about a fourth longer again than thick; the postmarginal vein a little shorter than the stigmal. Length of female, 1.66 to 1.67; length of male, 1.39 mm.

Series 8. Two females reared from a larva of *Coccinella novemnotata* Herbst, Cabin John Bridge, Maryland, June 25, 1900 (F. H. Chittenden). Nearly identical with series 5, but the abdomen with a bluish luster above, and a distinctly greenish luster on the venter. Length, 1.99 to 2.19 mm.

Series 9. Three females reared from a Coccinelline larva, Spartanburg, South Carolina, June 1, 1908 (G. G. Ainslie), Webster No. 4811–12. Like the preceding series but the head darker green, with the luster more bronzy green and becoming about taupe brown (R.) on the vertex in two of the specimens. The postmarginal vein about a fourth shorter than the stigmal. Length, 1.80 to 1.85 mm.

Series 10. Five females, one male reared from larva of *Hippodamia convergens* Guérin, June 28–29, 1896, Insectary No. 46$\frac{9}{1}$. Similar to series 7, but the mesopleura antique brown (R.) and the luster of venter more bluish in most of the specimens. First funicle joint about a half longer again than thick; the postmarginal vein about a fourth shorter than the stigmal. Length of female, 2.20 to 2.26; length of male, 2.15 mm.

Series 11. One female, Washington City. Practically identical with series 8. Length, 1.79 mm.

Series 12. One female, District of Columbia. Head about sea brown (R.) with a bronzy purplish luster, the postorbital region with a greenish luster; oral margin of face, the cheeks and lower half of occiput nearly raw sienna (R.); underparts of thorax antique brown (R.) with the posterior part of the mesopleura much darker and with a strong bluish or purplish luster; abdomen bluish black above, the venter greenish in luster; antennae blackish except the club; front and middle legs except the tibiae and tarsi antique brown, the front tibiae and tarsi and hind legs brownish black, the front tibiae and all the coxae with a purplish luster; middle tibiae dark brown; the tibial spur and middle tarsi except the last joint pale yellowish brown but probably more whitish in life. First funicle joint about a third longer again than thick; the postmarginal vein nearly as long as the stigmal. Length, 1.99 mm.

Californicus apparently intergrades through series 7 and 10 with *terminalis* (Say) and it seems best to consider it a subspecies. On the whole it occupies a more northern section of the country than *terminalis*, and has preserved the *flaminius* type of coloration.

Type.—Cat. No. 19338, U.S.N.M.

Table of measurements of californicus.

Series.	Locality.	Collector.	Length of body.	Width of mesoscutum.	Length of head.	Width of head.	Width of vertex.	Length of antenna.	Length of forewing.	Width of forewing.
			mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
1	Whittier, California.	Timberlake.	1.50	0.52	0.52	0.51	0.117	1.17	1.45	0.56
2	Salt Lake City, Utah.	.....do.....	1.89	.67	.67	.65	.138	1.50	1.83	.70
4	.....do.....	C.N.A lie	2.09	.65	.64	.62	.144	1.48	1.82	.72
5	Arlington, Massachusetts.	Dimmock...	2.03	.73	.68	.68	.155	1.59	1.86	.70
6	Springfield, Massachusetts.	.....do.....	1.99	.73	.71	.69	.153	1.60	1.93	.74
7	Indiana (?).....	Osborn.....	1.75	.63	.60	.60	.134	1.32	1.64	.61
8	Cabin John Bridge, Maryland.	Chittenden..	2.19	.70	.70	.66	.145	1.59	1.87	.71
9	Spartanburg, South Carolina.	G. G. Ainslie	1.80	.68	.66	.62	.134	1.51	1.76	.65
10	Unknown.....	Unknown...	2.20	.71	.73	.67	.150	1.61	1.90	.71
12	District of Columbia.	.....do.....	1.99	.64	.64	.65	.152	1.53	1.76	.65

5. HOMALOTYLUS MEXICANUS, new species.

Plate 38, fig. 5.

Female.—Agreeing closely in structural characters with *flaminius* (Dalman) and *terminalis* (Say), the head more like the former species although not quite so long as compared with the width, and thickest fronto-occipitally just opposite the middle of the eyes. Antennal scape slender as in *terminalis*, the pedicel one-third longer again than the first funicle joint; funicle joints all longer than thick, the first joint fully twice as long as thick, the following three about a half longer again than thick, the last two slightly shorter than the preceding; club not quite as long as the three preceding joints combined. Postmarginal vein nearly as long as the stigmal. Length of body, 1.73; length of head, 0.585; width of head, 0.545; width of vertex, 0.129; length of eye, 0.47; width of eye, 0.26; length of antenna, 1.51; width of mesoscutum, 0.59; length of forewing, 1.49; width of forewing, 0.545 mm.

Head, underparts of thorax, most of pronotum, and venter of abdomen about raw sienna (R.), the frontovertex and face shiny with a slight bronzy luster, the postorbital region slightly greenish; collar of pronotum and mesoscutum brownish black with a slight greenish luster; axillae buckthorn brown (R.), the scutellum yellow ocher (R.); mesoscutum, propodeum, and dorsum of abdomen shining blackish brown; tegulae white with posterior margin blackish brown. Antenna brownish black, with the last two funicle joints and the club yellowish white. Front and middle coxae, femora and middle tibiae yellow ocher (R.), the coxae and front femora slightly suffused with brownish, the basal half of middle tibiae considerably more brownish; the front tibiae and tarsi, and hind coxae and femora on outer side rather pale yellowish brown; hind

legs otherwise dark brown; spur of middle tibiae yellowish white, the middle tarsi about warm buff (R.), the last joint blackish, and the fourth joint slightly brownish. Wings banded as in *flaminius* or *terminalis*. Pubescence of scutellum blackish, of the head, mesoscutum and metapleura silvery white.

Male.—Not known.

Described from two females (type and paratype) reared from material of *Ceroputo yuccae* (Coquillett) on agave, Guadalajara, Mexico, November 10, 14, 1894 (C. H. T. Townsend), Townsend No. 33, Insectary No. 5726[06]. Both specimens have been partially eaten by museum pests and the head of the paratype is missing.

Type.—Cat. No. 22034, U.S.N.M.

6. HOMALOTYLUS ALBITARSUS Gahan.

Homalotylus albitarsus GAHAN, Canad. Entom., vol. 42, June, 1910, p. 206.

Female.—Agreeing closely with other forms of the *flaminius* group, the head being slightly longer than wide, the vertex a little wider than in *mexicanus*, and the ocelli very nearly in an equilateral triangle. Antennal scape more flattened than in *mexicanus*, a little expanded toward the apex and grooved beneath; first funicle joint about two-thirds as long as the pedicel and nearly a half longer again than thick, the following joints slightly shorter than the first, and all except the sixth a trifle longer than thick. Stigmal and postmarginal veins nearly equal in length, the angle between them very acute, the stigmal slender and slightly enlarged at apex.

Sculpture and pubescence as in *mexicanus*, but the frontovertex more opaque and the postorbital region smooth. Length, 1.50 mm.

Head, pronotum, axillae and scutellum about amber brown (R.), the head being a little paler and with a slight greenish luster on postorbital region; the underparts of thorax somewhat more yellowish; mesoscutum and abdomen blackish brown, the scutum with a slight metallic luster, the first tergite of abdomen a little more yellowish. Antennae blackish brown, the fourth funicle joint fading into whitish on the inner side at apex, the following funicle joints and club white. Front coxae and femora, most of middle legs, hind coxae and lower margin narrowly of hind femora concolorous with the pleura; front tibiae and tarsi pale brown; most of hind femora and hind tibiae blackish brown; middle and hind tarsi white, with the last joint brownish; the spur of middle tibiae yellowish white. Wings banded as in other species of the *flaminius* group. Pubescence as in *mexicanus*.

Male.—Not known.

Redescribed from two females (type and paratype) reared from an unknown Coccinellid larva, Washington County, Maryland, August 2, 1898.

Type.—Cat. No. 13223, U.S.N.M.

7. HOMALOTYLUS SCYMNI (Shimer).

Eutelus ? scymnae SHIMER, Trans. Amer. Entom. Soc., vol. 2, Nov., 1869, p. 385.

This species remains unknown to the writer. The description suggests *albitarsus* Gahan, but there seems to be enough difference to avoid synonymizing the latter species at least for the present. Ashmead, however, synonymized the species with *terminalis* (Say), on apparently insufficient evidence. Doctor Shimer reared his specimen from the larva of a *Scymnus* species feeding on *Chermes pinicorticis* (Fitch), probably at Mount Carroll, Illinois.

VICINUS GROUP.

KEY TO THE SPECIES OF THE VICINUS GROUP.

1. Head longer than wide, oval in outline.....2
   Head seen from in front hardly longer than wide, or nearly circular in outline; head and scutellum orange rufous, the mesoscutum greenish black, legs dark, blackish brown, the hind tarsi and three middle joints of middle tarsi white. 8. *quaylei*, new species.
2. Head and body not entirely black.....3
   Head and body black with green and bluish luster, legs black, the hind tarsi, and the three middle joints of the middle tarsi white, antennae black, the club and more or less of the preceding joint white.....9. *africanus*, new species.
3. Head and scutellum cadmium yellow, the mesoscutum and abdomen greenish black; front legs and middle tibiae pale brown, the middle femora, middle and hind tarsi whitish, the hind femora and tibiae blackish, antennae black, the club and last three or four funicle joints yellowish white..10. *oculatus* (Girault).
   General color more or less dark castaneous, the mesoscutum blackish with a greenish luster, the scutellum opaque black; legs castaneous with front and middle coxae, base of front and middle femora, and the hind legs blackish, middle tibial spur yellowish white, the three middle joints of middle tarsi and the hind tarsi except apical joint white, the lower margin of hind femora distally pale yellowish; antennae black or blackish, the club white.....11. *vicinus* Silvestri.

8. HOMALOTYLUS QUAYLEI, new species.

Plate 39, fig. 9.

Female.—Head in frontal view very nearly circular in outline, being a trifle longer than wide; the dorsal orbits of eyes strongly converging posteriorly so that the width of the vertex at the posterior ocelli is less than half that of the face at the lower corners of eyes; ocelli placed in a strongly acute-angled triangle, the posterior pair about one-third nearer the occipital margin than to the median ocellus; eyes slightly longer than in *H. flaminius*, and the head in side view somewhat thicker, being thickest below the middle instead of at the middle; face slightly protuberant between the bases of the antennae (the latter broken off in the unique type). Mandibles with moderately long teeth, the middle one slightly longer than the ventral and less acute, the inner or dorsal tooth shortest, distinctly not forming a subtruncate edge with the middle tooth, as the emar-

gination between them is distinct. Thorax and abdomen normal for genus, the ovipositor prominently protruded, the exserted portion about equal to one half the length of abdomen. Wings much as in *H. flaminius*, the subbasal area of hyaline cilia much narrower, the dark area at extreme base larger, the median fascia broader, its apical margin extending considerably beyond the apex of the venation and distinctly transversely truncate; the oval hyaline area reaching nearly to either margin of wing, the apical area of dark cilia only about a third wider again than the preceding hyaline spot instead of about twice as wide as in *H. flaminius*; the postmarginal almost as long as the stigmal vein. In other structural respects and in regard to the sculpture practically as in *H. flaminius*, except that the punctures on the front are rather less numerous and not so distinctly impressed. Length of body, 1.76; length of head, 0.59; width of head, 0.545; width of vertex, 0.103; length of eye, 0.51; width of eye, 0.265; width of mesoscutum, 0.60; length of forewing, 1.41; width of forewing, 0.535; length of ovipositor, 0.305 mm.

Head, pronotum, axillae, and scutellum orange rufous (R.), the vertex dusky and together with the frons slightly greenish metallic, the head otherwise mostly bronzy in luster, the pronotum narrowly greenish black along its posterior margin, mesoscutum distinctly greenish black with a strong luster; metanotum, propodeum, and abdomen slightly bluish black, the dorsum of abdomen with an iridescent luster; propleura, sternum, prepectal plates and anterior margin of mesopleura concolorous with pronotum but slightly more yellowish, the mesopleura otherwise shining clove brown (R.); tegulae white with the posterior margin dark brown. Antennae (according to field notes of Prof. H. J. Quayle) black or brownish black with the last funicle joint and club white. Legs rather dark or bluish brown, the front coxae and femora concolorous with propleura, the femora being a little duskier, middle femora paler brown with a tinge of yellowish, the middle tibial spurs dilutely brownish, second and fourth joint of middle tarsi and the apex of the first joint yellowish white; hind femora with a bluish luster and a narrow streak of yellow on their posterior margin except on the basal third, the hind tibiae more nearly black, the hind tarsi yellowish white except the last joint and the extreme base of the first joint. The broad fascia of wings deeply pigmented, as also the triangular dark spot at base; the apex of disk beyond the oval hyaline spot slightly pigmented but more evidently so than in other species. Exserted part of ovipositor yellowish, the apex becoming dusky. Pubescence on head whitish, on mesoscutum pale brownish, on scutellum black, and on the metapleura silvery white.

Described from one female reared from citrus mealy bug material (*Pseudococcus citri* Risso), in August, 1913, Sicily, Italy (H. J.

Quayle), Quayle's No. 9. The specimen without doubt issued from an unnoticed Coccinellid host.

Type.—Cat. No. 22035, U.S.N.M.

9. HOMALOTYLUS AFRICANUS, new species.

Female.—Head shaped nearly as in *H. flaminius*, but a little narrower, being distinctly although but little longer than wide, the sides more convex; as seen from in front appearing broadly oval; eyes proportionately longer than wide as compared with *H. flaminius;* the dorsal orbits strongly converging posteriorly, so that the vertex at the posterior ocelli is considerably less than half of the width of the space between the lower corners of eyes; ocelli in a very acute-angled triangle, the posterior pair touching the eye-margin, and nearly as far removed (about four-fifths as far) from the occipital margin as from the median ocellus; face slightly protuberant between the bases of the antennae. Scape linear, compressed, not at all dilated; pedicel as long as the first and three-fourths of the second funicle joint combined; funicle joints decreasing slightly in length distad, the first about one-half longer again than wide, the sixth about one-fourth longer again than wide; club equal to the last three funicle joints combined. Mandibular dentition as in *H. quaylei*. Thorax and abdomen proctically as in *H. flaminius* but less robust and the ovipositor protruded for a length about equal to one-half that of abdomen. Wings rather small and narrow, only one-third of forewing projecting beyond apex of abdomen, otherwise very nearly as in *H. quaylei* except that the subapical oval hyaline spot is somewhat smaller and not quite so close to apex of disk; the postmarginal vein equal to the stigmal in length. Otherwise in regard to structural characters like *H. flaminius;* sculpture the same except the frontovertex of head is noticeably more shining, and the pin-punctures are rather smaller and sparser, but distinct. Length of body, 1.72 (to 2.23); length of head, 0.59; width of head, 0.52; width of vertex, 0.101; length of eye, 0.505; width of eye, 0.244; length of antennae, 1.35; width of mesoscutum, 0.545; length of forewing, 1.34; width of forewing, 0.47; length of ovipositor, 0.30 mm.

Head metallic, shiny, dark cress green (R.); the face and oral margin sometimes suffused with yellowish brown in certain lights; thorax and abdomen bluish black, the pronotum and mesoscutum greenish black, all parts except the axillae and scutellum more or less metallic shining, the dorsum of abdomen iridescent metallic, the pleura and sternum of thorax in some specimens appearing slightly suffused with yellowish brown in bright light; tegulae white with the posterior margin blackish. Antennae black, becoming duller distad, the last funicle joint varying from blackish to yellowish white like the club. Legs black with a slight bluish luster on the coxae and

femora, the middle tibial spur pale brownish; the front tarsi blackish brown, middle pair yellowish white on third and fourth joint, sometimes also on the second and even on apex of first, otherwise blackish brown, hind pair yellowish white except on last joint and first extreme base of the first joint. Wings banded as in *H. quaylei* except as otherwise noted above. Exserted part of ovipositor sheaths pale brown. Pubescence on head whitish, on metapleura and hind coxae silvery white, and on the notum of thorax blackish and inconspicuous.

Male.—Similar to the female, except that the scape has a shallow notch just beyond the middle on the upper side. Length of body, 1.68 mm.

Described from five females, two males (type, allotype, and paratypes *a* to *e*) reared from *Pseudococcus* material, undoubtedly from a Coccinellid larva, Cape Town, South Africa. (Labeled, "bred from *Dactylopius* or Coccinellid".) The manuscript name applied by Dr. Ashmead has been adopted for this species.

Type.—Cat. No. 22036, U.S.N.M.

10. HOMALOTYLUS OCULATUS (Girault).

Plate 39, fig. 10.

Hemaenasoidea oculata GIRAULT, Annals Entom. Soc. Amer., vol. 9, Oct., 1916, p. 308.

Female.—Head shaped as in *H. africanus* yet distinctly more narrowly oval in outline as viewed from in front, being about one-fifth longer than wide; convergence of dorsal orbits and position of ocelli as in *H. africanus*; face slightly protuberant between antennal bases. Scape linear and compressed, not dilated; pedicel as long as the first and three-fourths of the second funicle joint; first funicle joint nearly a half longer again than thick, the rest gradually shortening, the sixth only a little longer than thick; club about equal to the last three funicle joints combined; mandibular dentition approximately as in *H. africanus*. Thorax and abdomen of normal structure, the ovipositor protruded for a length about equal to one-half that of abdomen. Wings practically as in *H. africanus*, except that the medial crossband is a trifle wider and reaches slightly farther beyond apex of venation, the subapical hyaline oval spot rather small and about equal to one-half or a little less than half the width of the intervening space to apex of disk; the postmarginal vein equal to the stigmal vein. In other structural details similar to *H. flaminius*, *quaylei*, etc.; the sculpture on the head, axillae and scutellum considerably finer and more alutaceous, the pin punctures on head evanescent and hardly evident without the closest scrutiny; sculpture of the other parts of the body not differing noticeably from that of *H. flaminius*, although finer on abdomen. Length of body, (1.48 to) 1.65; length of head, 0.57; width of head, 0.48; width of vertex, 0.096; length of eye, 0.48;

width of eye, 0.235; length of antenna, 1.19; width of mesoscutum, 0.54; length of forewing, 1.43; width of forewing, 0.535; length of ovipositor, 0.30 mm.

Scutellum and most of prothorax cadmium yellow (R.), the head somewhat paler or light cadmium yellow (R.) suffused with deeper yellow or brownish at the vertex; pronotum, except on the sides, and the mesoscutum greenish black, with a metallic luster, axillae dark reddish brown or more or less brown medially, otherwise like scutellum, metanotum and propodeum purer shining black; anterior corner of mesopleura cadmium yellow shading gradually into blackish brown on the remaining part which is shining but hardly metallic; tegulae white with the posterior margin broadly dark brown; abdomen black, appearing slightly bluish in certain lights, or iridescent metallic in others, the venter duller and more brownish; ovipositor sheaths pale cadmium yellow with apex blackish brown. Antennae blackish brown shading into yellowish white or pale yellow on distal half of flagellum, the last three funicle joints pale and the preceding joint also in some specimens. All the coxae dark brown or blackish brown, the front pair somewhat suffused with brownish yellow; front femora brownish yellow, the tibiae and tarsi brownish black; middle legs (except coxae) yellowish white with the tibiae pale brown, darker along upper margin; hind femora blackish brown with the lower margin narrowly yellowish, or entirely brownish yellow, darker at base and more yellowish toward apex and along inferior margin, the tibiae blackish, and the hind tarsi yellowish white with the last joint somewhat brownish. Wings banded as in *H. flaminius* except as noted above. Pubescence on head very fine, and silky, whitish in color; on the pronotum and scutum rather abundant, conspicuous, silvery white in color, on the scutellum appearing whitish in certain lights, but in others blackish, the apex furnished with about three or four longer hairs on each side, which are suberect and inclined inward to inclose a quadrate bare spot; metapleura and hind coxae furnished with usual appressed silvery white pubescence.

Male.—Similar to the female except that the scape has a rather deep, rounded notch or emargination just beyond the middle on the upper margin. The coloration of the single specimen is slightly paler than in any of the females, as the axillae are practically entirely concolorous with the scutellum, the mesopleura more brownish, and the middle tibiae yellow instead of pale brown. Length of body, 1.57 mm.

Redescribed from three females and one male reared from larvae of *Scymnus bipunctatus* Kugelann, Manila, Philippine Islands (H. S. Smith and D. T. Fullaway). The host may not be correctly de-

termined, but is a common species at Manila and has been introduced thence to California as an enemy of *Pseudococcus citri* (Risso).

The type female of *Hemaenasoidea oculata* Girault also examined.

This species is most closely related to *H. vicinus* Silvestri and the male has a peculiar notch on the upper margin of the scape as in that species, although rather better developed.

Type.—Cat. No. 19949, U.S.N.M.

11. HOMALOTYLUS VICINUS Silvestri.

Homalotylus vicinus SILVESTRI, Boll. Portici Lab., vol. 9, Feb., 1915, p. 293 figs. 50–51.

This species has not been seen by the writer. It was reared by Silvestri from the larva of a Scymnine, *Nephus cetustus* Weise, at Nefasit, Eritrea, Africa.

COCKERELLI GROUP.

KEY TO THE SPECIES OF THE COCKERELLI GROUP.

1. Head dark colored, diamine brown or raw umber, with a distinct metallic luster..4
   Head brownish yellow with the metallic luster weak or absent.....2
2. Frontovertex with an evanescent metallic luster: pubescence of scutellum dark colored; ovipositor not over a third as long as the abdomen.....3
   Frontovertex not at all metallic; scutellum with a pale pubescence; ovipositor over one-half as long as the abdomen; head and underparts of thorax ochraceous orange, the scutellum and axillae cadmium yellow, the mesoscutum dark brown to blackish with a greenish luster centrally; antennae black, the club and preceding joint white; front and middle legs and hind tarsi pale yellowish, hind legs otherwise dark brown or blackish except base of femora and the coxae.
   12. *cockerelli*, new species.
3. Ovipositor about one-third as long as abdomen; coloration nearly as in *cockerelli;* antennae black, the club white; legs dark brown or blackish with the coxae, front and middle femora yellowish, the spur of middle tibiae and the middle tarsi yellowish white.....13. *affinis*, new species.
   Ovipositor about one-fourth as long as abdomen; coloration nearly as in the two preceding species; antennae black with club and preceding joint white, legs paler than in *affinis*, the hind tibiae only remaining dark brown.
   14. *brevicauda*, new species.
4. Ovipositor fully one-half as long as abdomen; front moderately punctate; teeth of mandibles short; head raw umber with a strong bronzy metallic luster, mesoscutum metallic greenish black, the scutellum yellowish; front and hind legs dark brown or blackish, the front tarsi pale brown; middle legs and also sometimes the front femora brownish yellow, the tibiae paler apically, the spur and tarsi, except last joint, pale yellowish; antennae black, the last funicle joint and club white.....15. *hyperaspidis*, new species.
   Ovipositor about one-third as long as abdomen; front unusually thickly punctate; teeth of mandibles rather long; head diamine brown, the metallic luster not strong, thorax as in *hyperaspidis* but the scutellum more ferruginous; front and hind legs dark brown with a strong metallic purplish luster on front femora, middle legs yellowish brown, the tibial spur and tarsi pale yellowish; antennae black, the last two funicle joints and club yellowish white.
   16. *punctifrons*, new species.

12. HOMALOTYLUS COCKERELLI, new species.

Plate 39, fig. 6.

Female.—Head in general shape much as in *H. flaminius*, being a trifle (about one-thirteenth by measurement) longer than wide, and widest across the middle of the eyes; dorsal orbits not strongly convergent behind, the width of vertex at the posterior ocelli being a little more than half the distance between the lower corners of eyes; ocelli in an equilateral triangle or nearly so, the posterior pair in smaller specimens about one-third more farther apart than distance from either to the anterior ocellus, or to the occipital margin, or in larger specimens (with the vertex proportionately narrower) the posterior pair are a little closer together than space to anterior ocellus, and to the same degrees farther from the occipital margin, ocellar angle about 60° to 75°; the occipital margin more rounded than in *H. flaminius*; eyes shaped about as in *flaminius* but slightly wider below the middle; the face slightly protuberant between the antennal sockets. Antennal scape linear, compressed; the pedicel as long as the first funicle joint and three fourths of the second joint combined; the first funicle joint about twice as long as thick, the following joints becoming gradually a little shorter but hardly thicker, the sixth being about a third longer than thick; club nearly as long as the three preceding joints combined. Mandibles with three short subequal blunt teeth, the middle one slightly longer. Thoracic and abdominal structure not deviating from the usual type, the ovipositor protruded for a length about equal to one-half to two-thirds of the length of the abdomen, dependent upon how much the latter is contracted. Wings similar to those of *H. flaminius*, the medial cross-band of dark colored cilia a little wider, its basal margin much less oblique, and the apical margin straight instead of a little convex, the subapical oval spot of transparent cilia large, reaching nearly to either margin, its width nearly equal to the apical area of dark colored cilia; stigmal vein distinctly narrowed at its middle, the apex thus appearing more triangular than in *flaminius*, the postmarginal vein equal in length to the stigmal. Sculpture much as in *flaminius* but considerably finer, somewhat so on the head and especially so on the axillae and scutellum which are entirely opaque alutaceous, the reticulations of the first tergite of abdomen all a little longer than wide, and their longer axes all running longitudinally except across the base of the tergite and not at all coarser at the middle; pin-punctures on head rather numerous but very small and shallow. Length of body (1.15 to 1.83), 1.73; length of head, 0.565; width of head, 0.535; width of vertex, 0.160; length of eye, 0.41; width of eye, 0.24; length of antenna, 1.39; width of mesoscutum, 0.55; length of forewing, 1.52; width of forewing, 0.56; length of ovipositor, 0.405 mm.

Head ochraceous orange (R.), the cheeks and postorbital area of head with a trace of greenish luster; pronotum and mesoscutum dark brown or less suffused with black especially on the middle of the scutum, sometimes entirely brownish, or entirely blackish with a slight greenish metallic luster; axillae and scutellum cadmium yellow (R.), tegulae white with the apical margin dark gray or blackish, metanotum, propodeum, and metapleura shining brownish black; pleura and under parts of thorax about concolorous with the head, the posterior part of mesopleura sometimes suffused with brownish; abdomen mostly like head and pleura but more shining, the venter dusky apically and the apical half of dorsum blackish, the luster especially strong on the dorsum and somewhat iridescent, ovipositor concolorous with the apical fourth blackish. Antennae black, the scape brownish, especially on the upper side and toward the base, the fifth funicle joint changing to whitish at the apex, the sixth joint and club yellowish white. Legs concolorous with pleura of thorax, the middle coxae blackish, the hind femora most often suffused with blackish on apical half of outer surface and along the dorsal margin of the inner surface, the hind tibiae blackish brown; middle tibiae, especially apically, the spur and the middle and hind tarsi considerably paler yellow, the last joint of all tarsi dark brown or blackish. Wings banded as in *flaminius* except as noted above. Pubescence of head and thorax entirely whitish, most prominent on the dark colored mesoscutum and pronotum, the metapleura and hind coxae densely silvery white pubescent; the scutellum in addition has two short black bristles on each side at the apex.

Male.—Entirely similar to the female in structural and coloration characters, but averaging slightly smaller in size. Length of body, 1.07 to 1.51 mm.

Described from ten females, five males (type, allotype, paratypes *a–m*) reared from the larvae of *Hyperaspis trimaculata* (Linnaeus) associated with *Dactylopius confusus* Cockerell, on *Opuntia* or collected at *Dactylopius* colonies on *Opuntia*, Brownsville, Texas, January 20 to July 8, 1915 (P. H. Timberlake).

The following material also examined: A large series collected or reared with the types, January 20 to July 8, 1915; two females reared July 4, 1915, from a single host of the same species, collected at San Antonio, Texas, January 9; four females, one male, reared from a Coccinellid larva associated with *Dactylopius* species (the host larva probably the same as above), Guanajuato, Mexico, Insectary No. 5859*a* (U.S.D.A.); six females, two males, reared from *Dactylopius confusus* material, Point Isabel, Texas (C. H. T. Townsend), Townsend No. 650; six females, two males, reared from *Dactylopius* material, La Puerta, Tamaulipas, Mexico (C. H. T. Townsend),

Townsend No. 650. The last two series labeled "from (or on) *Coccus cacti*," the first record undoubtedly referring to *D. confusus* and the second probably so.

The name adopted for this species is one used by Dr. L. O. Howard in manuscript.

Type.—Cat. No. 22037, U.S.N.M.

13. HOMALOTYLUS AFFINIS, new species.

Plate 39, fig. 8.

Female.—Very similar to *H. cockerelli*, but differing as follows: Head about one-fourteenth longer than wide, the width of the vertex at the posterior ocelli proportionately wider in comparison with the width of head, but practically the same in comparison with the width of frons at the lower corners of eyes, being almost exactly one-sixth more than half that width; the posterior ocelli somewhat farther apart than distance from either to the median ocellus, the ocellar angle about 75°; eyes slightly smaller or narrower than in *cockerelli*, being hardly wider on the lower half than above. Antennae similar, the pedicel as long as the first funicle joint, together with three-fifths of the second; first funicle joint one-fourth longer than thick, the following becoming slightly shorter and thicker, the sixth about as long as thick; club as long as the last three funicle joints combined, the under side obliquely truncate on the apical two-thirds, rather indistinctly three-jointed, the sutures being visible under high magnification. Mandibles practically the same. Thoracic and abdominal structure as in *cockerelli*, except that the ovipositor is much more shortly protruded, being about only one-fourth as long as the abdomen. Wings with the ciliary bands practically the same, the subapical hyaline spot a little smaller; the stigmal vein less constricted toward the base, the apex appearing less enlarged; the postmarginal subequal to the stigmal. Sculpture of the head considerably more evident than in *cockerelli*, the punctures hardly larger except possibly on the vertex, but more deeply impressed, the pin punctures rather more numerous; axillae and scutellum with evident punctulate sculpture about as in *flaminius;* the first tergite of the abdomen with the reticulations much longitudinally narrowed on the sides, becoming gradually transversely lengthened across the base, and a little coarser and more equilateral on the medio-apical part; sculpture otherwise of the usual type. Length of body (1.39 to) 1.70; length of head, 0.587; width of head, 0.538; width of vertex, 0.185; length of eye, 0.434; width of eye, 0.230; length of antennae, 1.26; width of mesoscutum, 0.540; length of forewing, 1.32; width of forewing, 0.500; length of ovipositor, 0.227 mm.

Head nearly Mars yellow (R.), the clypeal margin more yellowish, the frontovertex more brownish with an obscure bronzy metallic

luster; mesoscutum and posterior margin of pronotum shining Sudan brown (R.) appearing darker in some lights and with a slight greenish luster; axillae and scutellum cadmium yellow (R.), the former sometimes more brownish; tegulae white, with the posterior margin brown; metanotum and propodeum shining reddish black; underparts of thorax about concolorous with the head, or somewhat more yellow, the posterior part of mesopleura appearing slightly brownish; center of abdomen brownish yellow, the dorsum Sudan brown (R.), but darker apically (in one specimen, paratype *a*, the basal half of the dorsum is brownish yellow like the center); ovipositor brownish yellow, becoming blackish on the apical third. Antennal scape brownish, the pedicel and funicle black, the club yellowish white. Legs at base concolorous with underparts of thorax, the front tibiae brownish, the front tarsi dark brown, middle tibiae dark brown with apex more yellowish, the spur yellowish white, the middle tarsi pale yellowish, the last one or two joints dark brown; hind legs with the coxae concolorous with the posterior part of the mesopleura, the femora shading into brownish on the apical half, the tibiae and tarsi brownish black. Wings banded as in *cockerelli* except as noted above. Pubescence of head, pronotum, and mesoscutum white, that of scutellum black; the thick, appressed pubescence of metapleura and hind coxae silvery white.

Described from three females (type and paratypes *a–b*) reared from larvae of *Hyperaspis osculans* LeConte, in colonies of *Dactylopius confusus* Cockerell, Uplands, California, June and October, 1914 (C. P. Clausen), Clausen's No. 8.

Type.—Cat. No. 22038, U.S.N.M.

14. HOMALOTYLUS BREVICAUDA, new species.

Plate 40, fig. 13.

Female.—Differs from *H. affinis* in the following respects: Head practically as wide as long, and almost perfectly circular in outline when viewed from in front, the width of the vertex at the posterior ocelli narrower than in *affinis* in comparison with the width of head and a trifle less than one-half the distance between the lower corners of eyes; ocelli in an equilateral triangle, or nearly so, the posterior pair about equidistant from the occipital margin and the median ocellus; eyes a little wider in proportion to their length than in *affinis*, and widest at the middle. Antennal scape slightly dilated on the lower, inner margin of the apical half; pedicel as long as the first funicle joint, together with four-fifths of the second; first five funicle joints practically equal in length, being very slightly longer than wide, the sixth slightly shorter than the others and about as long as wide, and no wider than the first; club indistinctly sutured, the underside obliquely truncate to the apex of the first joint, the

length almost equal to the last three funicle joints combined. Thoracic and abdominal structure as in *affinis*, except that the ovipositor is slightly shorter. Wings practically as in *affinis* with the subapical hyaline spot very slightly larger. Middle tibial spur noticeably longer than the first tarsal joint (not or hardly longer in other species). Sculpture practically the same as in *affinis* throughout. Length of body, (1.40 to) 1.83; length of head, 0.62; width of head, 0.62; width of vertex, 0.169; length of eye, 0.47; width of eye, 0.28; length of antennae, 1.46; width of mesoscutum, 0.62; length of forewing, 1.51; width of forewing, 0.57; length of ovipositor, 0.19 mm.

Coloration entirely like that of *affinis* except for the following particulars: Funicle more brownish black, the last joint white like the club; legs paler, the front tibiae with hardly more brown than the front femora, the front tarsi pale brown, the middle tibiae only slightly brownish toward the base, the hind femora very slightly brownish, the hind tibiae dark brown, the hind tarsi paler brown or even yellowish brown; abdomen sometimes suffused with yellowish at the base of the dorsum and becoming almost blackish toward the apex, the ovipositor sheaths hardly darker at the apex.

Male.—Entirely similar to the female. Length, 1.44 mm.

Described from four females, one male (type, allotype, and paratypes *a–c*), reared from a Scymnine larva associated with an *Orthezia* species on *Hymenoclea monogyra*, Ignacio, Durango, Mexico, October 12, 1894 (C. H. T. Townsend), Insectary No. 6448°. Three other specimens of uncertain sex from the same series but much eaten by pests may be considered metatypes.

Type.—Cat. No. 22039, U.S.N.M.

15. HOMALOTYLUS HYPERASPIDIS, new species.

Plate 39, fig. 7.

Female.—Head nearly circular in outline when viewed from in front, being very slightly longer than wide, the width of the vertex at the posterior ocelli a little over one-half the width of the frons at the lower corners of eyes, the ocelli very nearly in an equilateral triangle, the median ocellus being a trifle farther from either of the posterior pair than the distance between the latter which are situated at the usual distance from the occipital margin; eyes noticeably wider across the lower half. Antennal scape as long as the first funicle joint together with one-half of the second; the first funicle joint nearly one-half longer again than thick, the following joints nearly equal and a little longer than thick; club as long as the last two funicle joints together with two-thirds of the fourth joint, solid and strongly obliquely truncate on the inner side to or nearly to the base. Mandibles with three short, rather blunt, and nearly equal teeth. Thorax and abdomen of the usual structure, the ovipositor

protruded for a length fully equal to one-half that of the abdomen or a little more. Wings with median cross-band somewhat convex on its apical margin, the subapical hyaline area reaching nearly to either margin of wing and about one-fourth narrower than the apical area of dark colored cilia; postmarginal vein about as long as the stigmal, unusually thickened proximad and completely obliterating the space between its own base and that of the stigmal vein, so that without careful examination the marginal vein appears to be fully thrice as long as thick, or much longer than it actually is, stigmal vein very slender but becoming somewhat enlarged at apex. Sculpture about as in *H. cockerelli* except that the pin punctures of the head are larger and deeper, the reticulations on the first tergite of abdomen a little coarser than in *cockerelli*, but much finer than in *flaminius*, being longitudinally lengthened on the sides, transversely lengthened toward the base, and becoming no larger and mostly pentagonal at the middle of the posterior margin, the extreme base of the tergite remaining smooth. Length of body, (1.50 to) 1.76; length of head, 0.587; width of head, 0.571; length of eye, 0.448; width of eye, 0.258; width of vertex, 0.176; length of antenna, 0.46; width of mesoscutum, 0.575; length of forewing, 1.51; width of forewing, 0.552; length of ovipositor, 0.394 mm.

Head antique brown (R.) with a rather pronounced bronzy luster on face and frontovertex and a greenish luster on the cheeks and postorbital region; pronotum and mesoscutum metallic greenish black, the axillae dull antique brown, the scutellum deep chrome (R.), the metanotum and propodeum shining brownish black, tegulae white with the posterior margin blackish, underparts of thorax antique brown; abdomen shining blackish brown with a strong green and iridescent luster especially at the base, the venter suffused with antique brown but much darker at the sides, the ovipositor sheaths brown at the base and blackish on the apical third. Antennae black, with the sixth funicle joint and club yellowish white. Legs raw sienna (R.) with the coxae, front tibiae and hind femora raw umber (R.), the hind tibiae blackish, the middle tibiae somewhat dark brownish at base and becoming pale orange yellow (R.) at apex, the spur and the middle tarsi a little paler, the last joint of all tarsi blackish. Wings banded with fuscous as in other species with the peculiarities noted above. Pubescence of head and mesoscutum whitish, of the scutellum blackish, and that of the metapleura silvery white.

Male.—Entirely similar to the female throughout. Length, 1.40 mm.

Described from four females, one male (type, allotype, and paratypes *a–c*) reared from larvae and pupae of *Hyperaspis undulata* (Say), Murray, Utah, July 12–29, 1913, and spring of 1914, the

atter from a single larva collected Sept. 22, 1913 (L. P. Rockwood), Salt Lake Laboratory No. 1551; and one female (paratype *d*), Los Angeles County, California (D. W. Coquillett).

Type.—Cat. No. 22040, U.S.N.M.

16. HOMALOTYLUS PUNCTIFRONS, new species.

Female.—Closely related to *H. hyperaspidis* and differing structurally as follows: Head barely longer than wide and except for the broadly truncated oral margin appearing circular in outline when viewed from in front, width of the vertex at the posterior ocelli noticeably more than one-half the width of the frons at the lower corners of eyes, both of these spaces being greater than in *hyperaspidis;* ocelli nearly in an equilateral triangle, the median ocellus being slightly closer to either of the posterior pair than the distance between the latter; eyes considerably narrower than in *hyperaspidis* and hardly perceptibly narrower on the lower half. Antennal scape noticeably slenderer than in *hyperaspidis* and barely expanded apically on the inner margin; pedicel as long as the first funicle joint together with one-half of the second; all the funicle joints longer than thick, the first nearly twice as long as thick, the following gradually shortening, the sixth about one-fourth longer than thick; club (broken off at apex) probably about as long as the last two funicle joints together with one-half of the fourth joint. Mandibles with the three teeth considerably longer and sharper than in *hyperaspidis* (or other species), the inner or dorsal tooth being much shorter than the other two. Ovipositor slightly shorter than in *hyperaspidis,* being nearly one-half as long as abdomen. Wings poorly preserved in the unique type, but enough remains to show that they are of the usual type, the ciliary banding apparently much as in *hyperaspidis;* the postmarginal vein thickened at the base as in that species, but the stigmal considerably shorter and not nearly so slender, being noticeably shorter than the postmarginal with the thickened apical part nearly as long as the slender basal part. Sculpture throughout much as in *hyperaspidis* but the pin-punctures on the head considerably more numerous, the minute punctation of the scutellum rather finer and hardly evident under a magnification of 65 diameters; the reticulations of the first abdominal tergite much less lengthened on the sides and more transversely lengthened at the middle of the posterior margin, and the smooth or nearly insculptate area across the base a little wider. Length f body, 1.75; length of head, 0.601; width of head, 0.582; width of vertex, 0.188; length of eye, 0.467; width of eye, 0.237; length of antenna (estimated in part, the tip of the club being broken off), 1.51; width of mesoscutum, 0.559; length of ovipositor, 0.244 mm.

Head liver brown (R.), the metallic luster weak and indeterminate, cheeks, postorbital region and occiput raw umber (R.) with a slight greenish luster, the oral margin of face raw sienna (R.); pronotum, mesoscutum, metanotum, and propodeum shining blackish, the luster of the scutum hardly greenish, scutellum antique brown (R.), the axillae much darker brown, tegulae white with a large triangular brown mark on the posterior margin; underparts of thorax raw sienna, the upper part of mesopleura suffused with brown and with a slight suggestion of purple; abdomen shining blackish with a greenish luster, the venter and apex of dorsum more brownish; ovipositor sheaths blackish brown with the basal third pale yellowish brown. Antennae black with the last two funicle joints and the club yellowish white. Legs blackish brown, the front and hind coxae and front femora somewhat purplish; the middle femora and apex of middle tibiae much paler or about antique brown (R.) the middle tarsi and tibial spur pale orange yellow (R.), the last tarsal joint blackish. Wings banded apparently as in *hyperaspidis*. Pubescence as in *hyperaspidis*, except that that of the scutellum is more abundant and whitish.

Described from one female (type), Jacksonville, Florida, presumably collected by W. H. Ashmead.

Type.—Cat. No. 22041, U.S.N.M.

ANISOTYLUS, new genus.

Female.—Head moderately thick fronto-occipitally, the face somewhat inflexed, as seen from the side the outline of the dorsal part convex, the facial outline straight, the two meeting each other roughly in an angle of somewhat more than 90°; seen from in front the outline of the dorsal part of head circular, the effect broken below by the moderately converging cheeks and the transversely arched and broad oral margin; the frontovertex moderately narrow, the length being nearly thrice the width, the dorsal orbits slightly diverging anteriorly; ocelli in an acute-angled triangle, the posterior pair almost touching the eye margins; eyes nearly twice as long as wide, the dorsal orbits convex, the ventral nearly straight, the longer axis much more nearly parallel with plane of the frontovertex than of either the face or occiput; the latter but slightly concave with the neck inserted near the center; cheeks somewhat shorter than the width of the eyes; the face with slightly impressed linear scrobes which converge above in an acute angle but do not quite meet. Antennae inserted rather far apart, close to the clypeal margin, in structure the same as in *Homalotylus*, the club solid. Labrum usually well exposed, the margin convex. Mandibles thick at the base and tapering to the moderately narrow, bidentate apex, the teeth being rather short and not very acute, and on the side of the inner or dorsal tooth is a slight trace or rudiment of a third tooth.

Labial palpi with three joints; the maxillary with four joints, the two basal ones subequal, the apical one about twice as long, the third a little shorter than the apical. Thorax, legs, and abdomen practically as in *Homalotylus*, the ovipositor not protruded. Wings differing in having the stigmal and postmarginal veins meeting in a much less acute angle, the postmarginal only about one-half as long as the stigmal, which is noticeably shorter than in *Homalotylus;* the basal and subapical areas of paler-colored cilia present, the integumentary fuscous spot beneath the stigmal vein reaching but little more than halfway across the disk of the wing.

Male.—Similar throughout to the female.

Anisotylus presents a combination of the characters of *Homalotylus* Mayr and *Isodromus* Howard. In the shape of the head it is like the latter; in the structure of the thorax and abdomen it is not unlike *Homalotylus*, and in the venation of the wings it is intermediate between the two. The bidentate mandibles, in which it differs from either, by no means indicate relationship with the Ectromatini, as the genus is unmistakably closely allied to *Homalotylus*. The sculpture and pubescence in character and arrangement are of the same type as in *Homalotylus*. The species so far as known are parasitic in the larvae of *Scymnus* and *Hyperaspis*.

Type of genus.—*Homalotylus similis* Ashmead.

KEY TO THE SPECIES AND SUBSPECIES OF ANISOTYLUS.

1. Distal half of flagellum yellowish white 3
   Flagellum entirely black or dark brown.
   Mesoscutum metallic greenish black 2
   Mesoscutum and abdomen metallic purplish black; the frontovertex and scutellum Sanford's brown; rest of head and underparts of thorax brownish yellow ..... 1. *similis* (Ashmead)
2. Frontovertex, axillae, and scutellum zinc orange; the rest of head and underparts of thorax brownish yellow; the abdomen bronzy black above, the venter more or less yellowish ..... 2. *similis texanus*, new subspecies.
   Frontovertex ochraceous orange; the rest of head and underparts of thorax a little paler yellow; the abdomen and the entire notum of thorax, except rarely the scutellum, greenish black ..... 3. *similis utahensis*, new subspecies.
3. Head, underparts of thorax, venter, and legs except hind tibiae yellow, the notum of thorax and dorsum of abdomen greenish black .. 4. *pallentipes*, new species.

1. ANISOTYLUS SIMILIS (Ashmead).

Homalotylus similis Ashmead, Trans. Amer. Entom. Soc., vol. 14, Nov., 1887, p. 190.

Female.—Head slightly longer than wide, the frontovertex about twice as long as the width at the ocelli, the latter in an acute-angled triangle, with the space between the posterior pair about equal to three-fourths of the space between either and the anterior ocellus. Scape increasing slightly in width from the base toward the apex, being somewhat expanded along the inner ventral margin; pedicel

nearly equal in length to the first two funicle joints; the funicle joints increasing slightly in thickness and less distinctly in length distad, the sixth, however, distinctly longer than the fifth, and all a little wider than long; club nearly as long as the last three preceding joints combined, solid and obliquely truncate from the apex nearly to the base on the inner side. Thorax and abdominal structure practically as in *Homalotylus flaminius*, the ovipositor not protruded. Wings with cilia on basal third of disk, and those in an oval spot in the middle of the disk just distad and below the apex of the stigmal vein, transparent and weaker; the speculum as in the species of *Homalotylus;* stigmal vein rather thick, only slightly enlarged at apex, and forming an angle of about 45° with the postmarginal, which is about one-half as long or a trifle more. Head finely punctulate, a trifle more coarsely so than in *H. flaminius*, the pin punctures few, very shallow, and evanescent; mesoscutum finely scaly-reticulate, the mesopleura finely reticulate, with the reticulations arranged in longitudinal lines, especially on the posterior half: axillae and scutellum opaquely punctulate, the punctures finer and more closely set than those on the head; side pieces of the metascutum transversely aciculate; first abdominal tergite scaly-reticulate on the posterior half and entirely smooth across the base, the reticulations at the sides hardly larger than those on the mesoscutum, but gradually becoming medially much larger and transversely lengthened except at the posterior margin. Pubescence on face, cheeks, and mesoscutum whitish, that on the face and cheeks not very thick; the metapleura and hind coxae with an appressed silvery white pubescence as in the species of *Homalotylus*. Length of body, 1.65; length of head, 0.59; width of head, 0.56; width of vertex, 0.141; length of eye, 0.43; width of eye, 0.28; length of antennae, 1.02; width of mesoscutum, 0.59; length of forewing, 1.41; width of forewing, 0.56 mm.

Frontovertex of head and the scutellum Sanford's brown (R.), the rest of the head, the pronotum and underparts of thorax similar but a little more yellowish, the postorbital region of head with a slight greenish luster, the center of the occiput and concealed part of pronotum blackish; the axillae considerably darker than the scutellum or about auburn (R.), and with a purplish luster in a strongly oblique view; tegulae white, with the apex pale brown; mesoscutum and abdomen blackish with a strong metallic purplish luster, the metanotum, propodeum, and metapleura similar but with a weaker luster. Antennal scape concolorous with face, but darker at apex, the pedicel and flagellum darker brown, the club paler brown, especially along the truncated margin. Legs concolorous, with underparts of thorax, front and middle tibiae, and the hind femora a little more brownish; the hind tibiae blackish brown; the middle tibial spur, first joint of middle tarsi and the hind tarsi, except the last two joints,

yellowish white. Wings hyaline, with a roundish, fuscous spot beneath the apex of the venation and reaching about two-thirds of the way across the disk.

Male.—Not known.

Redescribed from one female, Biscayne, Florida, May 17 (E. A. Schwarz), which had been compared with Ashmead's type female from Jacksonville, Florida, and found identical.

Type.—Cat. No. 4745, U.S.N.M.

2. ANISOTYLUS SIMILIS TEXANUS, new subspecies.

Female.—Practically identical with *A. similis* (Ashmead) in all structural characters. Length of body, (1.62 to 1.80) 1.72; length of head, 0.63; width of head, 0.59; width of vertex, 0.15; length of eye, 0.45; width of eye, 0.29; length of antenna, 1.07; width of mesoscutum, 0.63; length of forewing, 1.57; width of forewing, 0.58 mm.

Frontovertex about zinc orange (R.), the ocellar region infuscated, or even metallic greenish as in paratype *a*, the rest of the head brownish yellow, but considerably purer yellow at the scrobes of the face; the scutellum and axillae like the frontovertex but a little more brownish, the axillae especially brownish medially, and sometimes metallic greenish as in paratype *a;* most of the pronotum and the underparts of thorax brownish yellow practically concolorous with the head; posterior margin of pronotum and the mesoscutum greenish black with a metallic luster, the posterior corners of the scutum more or less brownish along the margin; tegulae white with the posterior margin brown; metanotum, propodeum, metapleura, and dorsum of abdomen shining blackish brown and with a slight bronzy luster on the abdomen especially at the base, the apex of the last tergite yellowish; venter of abdomen brownish yellow with a bronzy luster and more infuscated medially. Antennal scape yellowish brown, the pedicel a little darker, the flagellum brownish black. Legs brownish yellow, the front and middle tibiae a little more brownish, the hind tibiae blackish brown, the middle tarsi, spur and the hind tarsi yellowish white except the blackish apical joint of the middle pair and the two dusky apical joints of the hind pair. Wings as in *A. similis* (Ashmead).

Male.—Not known.

Described from three females (type and paratypes *a* to *b*), the type collected on sorghum heads, San Antonio, Texas, June 27, 1908 (C. N. Ainslie), Webster No. 5009; paratype *a* reared from a pupa of *Hyperaspis bigeminata* Randall, Austin, Texas, May 25, 1917 (Carl Hartmann), Hartmann's No. 63; paratype *b* reared from an undetermined Coccinellid larva, Brownsville, Texas (C. H. T. Townsend), Townsend's No. 645.

Type.—Cat. No. 22042, U.S.N.M.

3. ANISOTYLUS SIMILIS UTAHENSIS, new subspecies.

Plate 40, fig. 11.

Female.—Entirely similar to *A. similis* (Ashmead) in structural characters. Length of body, (1.35 to 2.03) 1.77; length of head, 0.63; width of head, 0.62; width of vertex, 0.155; length of eye, 0.47; width of eye, 0.30; length of antenna, 1.13; width of mesoscutum, 0.655; length of forewing, 1.57; width of forewing, 0.63 mm.

Frontovertex ochraceous orange (R.), the rest of the head and underparts of thorax a little paler, the scrobes of the face purer yellow, the ocellar region of vertex suffused with metallic dark green, the postorbital region with a slight greenish metallic luster, the center of the occiput and posterior margin of mesopleura dusky; entire upper parts of thorax including pronotum, the metapleura, and abdomen metallic blackish green, the axillae and scutellum opaque in most aspects, the pronotum with a faint ochraceous transverse line just before the posterior margin, the scutellum in two paratypes, *a* and *b*, more or less dusky ochraceous orange, in one distinctly so only at the sides, in the other entirely so except at the base; tegulae white with the apical margin broadly brown. Antennae brownish black, the scape on the upper side more brownish, often pale brown. Front and middle coxae and front femora very nearly concolorous with underparts of thorax, front tibiae and tarsi and the middle and hind femora a little more brownish, sometimes distinctly so, the middle tibiae and hind tibiae and tarsi blackish brown, the latter more brownish underneath; hind coxae varying from dusky yellow to more or less blackish with a greenish metallic luster, the middle tarsi and spur yellowish white with the last two joints of the tarsi dusky. Wings as in *A. similis* (Ashmead).

Male.—Entirely similar to the female, although the head is somewhat purer yellow in color. Length, 1.27 to 1.69 mm.

Described from 10 females, five males (type, allotype, and paratypes *a* to *m*), selected from a large series reared from larvae of *Scymnus americanus* Mulsant and *Scymnus lacustris* LeConte, Murray and Salt Lake City, Utah, May to September during the seasons of 1913 to 1915 (P. H. Timberlake).

At first sight this form looks distinct enough to bear specific rank, but in the absence of any structural characters to separate it from *A. similis* (Ashmead) it seems best to consider it a geographical race of that species. The rare individual variation with the orange-colored scutellum is strikingly similar to *A. similis texanus*, and gives additional weight to the belief that the three forms are geographical variants of one species.

Type.—Cat. No. 22043, U.S.N.M.

4. ANISOTYLUS PALLENTIPES, new species.

Plate 40, fig. 12.

Female.—In structure very close to *A. similis* (Ashmead), but the following differences may be noted: Head very slightly longer in proportion to the width, the vertex somewhat narrower and the ocelli in a more acute triangle, the distance between the posterior pair being about three-fifths of the distance between either and the median ocellus; antennae a little longer and slenderer, the first three funicle joints being a little longer than thick, the sixth a trifle wider than long; subapical spot of transparent cilia on the forewing unusually small and evanescent, situated near the middle of the disk and roundish in shape; the postmarginal vein a little shorter and more spur like; sculpture throughout a little finer, especially on head, the pin-punctures of the head entirely effaced; pubescence the same, except that the eyes bear a few extremely short, scattered hairs. Length of body, 1.50; length of head, 0.58; width of head, 0.53; width of vertex, 0.117; length of eye, 0.43; width of eye, 0.27; length of antenna, 1.12; width of mesoscutum, 0.59; length of forewing, 1.46; width of forewing, 0.60 mm.

Head light cadmium yellow (R.), becoming a little darker on the frontovertex, the region around the posterior ocelli suffused with blackish, center of occiput and concealed part of pronotum black; the propleura, prepectal plate, and anterior margin of mesopleura pale lemon yellow (R.), this color ascending onto pronotum as a narrow, transverse preapical line, on posterior lateral margins of mesoscutum and the base of the axillae; the rest of mesopleura ochraceous orange (R.); posterior margin of pronotum narrowly, mesoscutum except the lateral posterior margin, most of axillae and the scutellum greenish black with a strong metallic luster, the axillae and scutellum opaque, however, in most aspects; metanotum, propodeum, and metapleura brownish black, somewhat shining but not metallic; tegulae white, with the posterior margin broadly brown; dorsum of abdomen blackish with a slight greenish luster at the base, the venter brownish yellow. Antennal scape and pedicel yellowish brown on the upper side, much darker beneath, the first three funicle joints blackish brown, the fourth joint very pale brownish, following joints and club maize yellow (R.). Front legs buff yellow (R.), the tarsi brownish; the middle and hind legs similar, but the middle femora and hind coxae and femora slightly paler, the hind tibiae pale brown; the middle tarsi and spur maize yellow, the last tarsal joint brownish at apex, the hind tarsi with the two basal joints maize yellow, and the apical joints pale brownish. Wings with a median smoky cross band beneath the stigmal and apex of the submarginal vein, extending across the disk but interrupted by a narrow longi-

tudinal hyaline line some distance from the posterior margin, the cut-off portion narrower and somewhat less deeply pigmented.

Male.—Not known.

Described from one female (type), Oracle, Arizona, May 7 (Hubbard and Schwarz).

Type.—Cat. No. 22044, U.S.N.M.

Genus ISODROMUS Howard.

Isodromus HOWARD, Rep. Entom., U. S. Dept. Agric., for 1886, 1887, p. 488, pl. 3, fig. 1.

Parataneostigma GIRAULT, Annals Entom. Soc. Amer., vol. 8, Oct., 1915, p. 275

This genus is similar to *Homalotylus* in general structure, but differs in details as follows:

Female.—Head thicker fronto-occipitally, not subhemispherical as the face is distinctly inflexed; a little wider than the mesoscutum, as wide as long or a little wider than long, as seen from in front the outline circular above, but below the cheeks converge in a straight line to a slight extent and the oral margin is broadly truncate: as seen from the side the outline is subtriangular, the outline of vertex rounded, the dorsal side of head being strongly convex, its plane meeting the plane of the face at somewhat more than a right angle as in *iceryae* or in a strongly obtuse angle as in *niger*: occiput slightly more concave above than in *Homalotylus* but yet only moderately so, the vertico-occipital margin rather sharp; frontovertex moderately wide, the dorsal orbits of eyes only slightly or hardly perceptibly diverging anteriorly; ocelli in an equilateral or a somewhat more acute-angled triangle, the posterior pair touching or nearly touching the eye-margins; eyes shorter than in *Homalotylus* or considerably less than twice as long as wide, their long axis parallel with the plane of frontovertex, the postorbital space on the sides of head remaining broad as in *Homalotylus*, and posteriority the eyes meet or almost meet the vertico-occipital margin; cheeks about as long as the width of the eyes as in *iceryae* or about two-thirds or three-fourths as long as in most species; face about as wide as long, the scrobes in the form of distinct and narrow furrows, converging above but not meeting, the space between the antennal sockets slightly convex but not prominently elevated. Antennae inserted as in *Homalotylus* shorter and somewhat more robust; scape of the same shape but shorter, the radicle joint about an eighth or tenth of the total length; pedicel as long as the first two funicle joints combined; funicle cylindrical, increasing slightly in thickness distad, the basal joints about as long as thick, the apical ones somewhat wider than long; club wider across the base than apex of funicle, as long or a little longer than the last three funicle joints combined, and obliquely truncate on the inner side to the basal third or fourth. Mandibles robust,

broad at apex, with three short, equal or nearly equal teeth, of which the lower two are acute, and the upper or inner one is much rounded at apex. Palpi short, the maxillary pair four-jointed, with the basal joint very short, the second about twice as long, the third and fourth increasing still more in length, the fourth being about twice as long as the second and slenderer; labial pair three-jointed, with the middle joint as long as thick, the other two subequal and a little longer.

Thorax rather more robust than in *Homalotylus*, but not differing much in structure except that the axillae meet broadly at their tips and are not infrequently slightly elevated above the surface of the scutellum; the latter more to much more convex and slopes downward more toward the sides and especially toward the apex, the margin, however, from base to apex generally well elevated and abruptly declivous; propodeum the same except that it is declivous or slopes downward from in front toward the abdomen, instead of being flat as in *Homalotylus;* mesepimeron visible as a very narrow sclerite along the posterior margin of the mesopleura. Legs about the same, except that the middle tibial spur is rather shorter, or about three-fourths as long as the first tarsal joint. Wings of the same comparative length but averaging a little wider than in *Homalotylus;* marginal vein always punctiform, the stigmal sometimes originating just before the submarginal vein reaches the costal margin, moderately long, straight and forming a right angle with the postmarginal as in *iceryae* or somewhat less than a right angle as in most of the species, postmarginal short and spur-like as in *iceryae* or nearly one-half as long as the stigmal as in *vinulus* and *puncticeps;* the disk ciliated about as in *Homalotylus* except that the subapical spot of transparent cilia is absent, the speculum indistinct except in *axillaria*, *puncticeps*, and *atriventris*, and the basal third of disk is usually bare or nearly so instead of being covered with transparent cilia; hind wings a little wider, the costal cell being wider and not so attenuated near the hooklets.

Abdomen narrower than in *Homalotylus*, about two-thirds as long as the thorax in most species or a little more and always longer than wide, with the base broad, the sides parallel or subparallel and the apex nearly truncate, or the base narrower and the sides more or less convex as in *vinulus*, *puncticeps*, and *atriventris;* first tergite reaching about one-third to nearly one-half of the distance from base to apex, the seventh tergite ranking next in length; tactile plates situated a little nearer to the middle than to the apex of abdomen, the vibrissae considerably longer and more conspicuous than in *Homalotylus* and reaching to the apex; structure of venter hardly differing from *Homalotylus*, the ovipositor enclosed by the fifth ventrite and not distinctly protruded in the known species.

Sculpture of the head finely punctulate, very minutely and alutaceously so in *iceryae* and *axillaris*, but more distinctly so in other species, especially in *niger*, the postorbital region and occiput smooth or with indistinct sculpture except in *niger*, which has a reticulate sculpture on the postorbital region, and a fingerprint-like sculpture on the occiput; frontovertex with small, shallow pin-punctures more or less regularly arranged in several rows but sometimes absent as in *iceryae;* pronotum and mesoscutum finely scaly-reticulate as in *Homalotylus*, the axillae and scutellum with a similar, but generally coarser and more deeply impressed sculpture than the scutum, and not opaquely punctulate as in *Homalotylus;* pleura and dorsum of abdomen sculptured as in *Homalotylus*, but the reticulation on the abdomen generally much more uniform in size and regular in shape.

Pubescence throughout as in *Homalotylus*, the mesepimera being silvery pubescent like the metapleura. Coloration black, or black variegated with yellow, brown or orange ferruginous, often shiny, but never distinctly metallic.

Male.—Hardly differing from the female except in the primary sexual characters.

Type of genus.—Isodromus iceryae Howard.

The species so far as known all parasitize Chrysopid larvae and issue from the cocoons of their hosts. At least two species, *iceryae* and *niger*, are also known to attack Hemerobiids.

Of the species belonging to *Isodromus*, *intermedius* (Boheman) was synonymized by Thomson with *vinulus* (Dalman), *chrysopae* (Ashmead) is here synonymized with *puncticeps* (Howard), and two recent species of Girault, *pulcher* and *nigriaxillae* appear to be nothing but color variations of *iceryae* Howard, differing only in the extension of the yellow markings. For the latter species Girault needlessly erected the genus *Parataneostigma* and incomprehensibly placed it among the Tanaostigmatini. The species belonging here were included by Mayr in *Homalotylus*, and by Thomson in *Nobrimus*.

Isodromus abnormicornis Girault [1] does not conform with *Isodromus* in several particulars, and should be placed in the new genus, *Brethesia*, described below.

KEY TO THE SPECIES OF ISODROMUS.

1. Wings with a large brown spot beneath the stigmal vein..... 4
   Wings without a large brown spot on the disk.
   General color black or blackish brown varigated with yellow or mostly yellow... 2
   Head and body entirely black, except that the face and frons in the male are yellow; antennae dark brown, front and middle legs brownish yellow, the hind legs brown, the middle and hind tarsi and middle tibial spur yellowish white.
   1. *niger* Ashmead.

[1] Insec. Insc. Menst., vol. 4, Jan., 1917, p. 118.

2. Hind tibiae unicolorous and not annulated with black..... 3
Hind tibiae yellow with two black or blackish brown annuli; head and body yellow; the center of occiput, pronotum except the collar, anterior half of mesoscutum, axillae, generally most of scutellum except apex, metanotum, propodeum, dorsum of abdomen except the base and a spot behind the tactile plates, and a spot on each side of venter near the middle shining black or blackish brown; scape and pedicel yellow, the flagellum more brownish..... 2
2. *iceryae* Howard.

3. Shining blackish brown, but the head, collar of pronotum, hind border of mesoscutum, axillae, anterior half of pleura and the legs except the hind tibiae yellow, the latter blackish; antennae yellow, with the club pale brown..... 3
3. *flaviceps* (Dalman).
General color wax yellow but the frontovertex, most of mesoscutum and the scutellum in the female pale ochraceous orange; hidden part of pronotum, axillae, propodeum and most of dorsum of abdomen brownish black; legs yellow, the tibiae a little darker, the tarsi more whitish; scape and pedicel yellow, the flagellum brownish yellow..... 4. *axillaris*, new species.

4. Head and thorax mostly orange ferruginous..... 5
General color blackish brown, but the head and mesopleura more brownish, the collar of pronotum whitish, the posterior corners of mesoscutum yellow; legs dark brown, the front tibiae paler, the front and middle femora and tibial spur brownish yellow; antennae brown..... 5. *vinulus* (Dalman).

. General color orange ferruginous but the metanotum, propodeum, abdomen, hind tibiae, and all tarsi in large part dark brown or brownish black; the brown spot on wings restricted; frontovertex hardly over two and a half times longer than wide; axillae elevated above level of scutellum... 6. *atriventris* Ashmead.
Color similar but the mesoscutum sometimes brownish except at the posterior corners and only the dorsum of abdomen blackish brown: the brown spot on wings extending across the disk; frontovertex about three times as long as wide; axillae hardly elevated, and the scutellum generally much less convex..... 7
7. *puncticeps* (Howard).

1. ISODROMUS NIGER Ashmead.

Plate 41, fig. 19.

Isodromus niger ASHMEAD, Proc. U. S. Nat. Mus., vol. 22, 1900, p. 379.

Female.—Head only moderately thick fronto-occipitally, the planes of the frontovertex and face meeting in an obtuse angle, the dorsal surface not much shorter than the facial surface in side view; frontovertex rather narrow but short or about two and one-half times longer than wide, the dorsal orbits slightly convex so that the frontovertex is narrowest just before the median ocellus; ocelli forming an angle of somewhat less than 60°, the posterior pair almost touching the eye margins, the median ocellus situated a little behind the middle of the frontovertex; antennal sockets rather close together, the distance between them equaling their length, their inner rims nearly parallel; scrobes distinct, reaching well above a line connecting the lower corners of eyes. Antennae short, the scape subcylindrical, somewhat thicker on apical half and with a pedicellar furrow on the underside near apex; pedicel as long as the first two funicle joints combined; funicle joints increasing somewhat in width distad, all

but the first distinctly wider than long; club showing a trace of segmentation, obliquely truncate to the basal fourth, wider at base than the last funicle joint, and as long as the last three funicle joints and one-half of the third combined. Mandibles with three short teeth, the lower two acute, and the upper or inner one blunt. Axillae slightly elevated above the scutellum; the latter moderately convex, sloping toward the sides and apex, and with a median impressed line for a short distance at the base. Wings broad, basal area of wing with a few scattered cilia, the speculum indistinct; stigmal vein forming somewhat less than a right angle with the postmarginal and originating before the submarginal quite reaches the costal margin, postmarginal vein about a third as long as the stigmal. Abdomen narrow, about a half longer again than wide and two-thirds as long as the thorax or a little more, the sides subparallel or but slightly curved, the base rather broad, the apex truncate; tactile plates situated a little less than halfway from the middle to the apex; the ovipositor concealed. Sculpture more prominent than in other species of the genera, but of the same character; the frontovertex with about six rows of small, shallow but distinct pin-punctures, the postorbital region finely reticulate, the occiput with a fine fingerprint-like lineolate sculpture; mesoscutum with fine but distinct reticulations, the axillae and scutellum with the reticulations not much coarser but much more deeply impressed and generally lengthened or otherwise irregular surrounding the impressed line at the base of the scutellum; the first tergite of abdomen with the reticulations comparatively coarse, but nearly as delicately impressed as those of the scutum, and uniform in shape and size from base to apex. Pubescence white and prominent on head, pronotum, mesoscutum and especially on metapleura and hind coxae, but more scattered and less prominent on the axillae and scutellum and somewhat darker in color. Length of body, 2.02 (to 2.39); length of head, 0.72; width of head, 0.685; width of vertex, 0.195; length of eye, 0.51; width of eye, 0.32; length of antenna, 1.04; width of mesoscutum, 0.74; length of forewing, 1.82; width of forewing, 0.73 mm.

Coloration rather shiny but not metallic black; tegulae white, with the outer, apical corner broadly blackish. Scape brown, the pedicel and flagellum blackish brown. Legs brownish yellow, the middle and hind coxae mostly blackish, the middle femora darker brown, the hind tibiae especially on the upper side brownish black, middle and hind tarsi and tibial spur yellowish white, with the last joint of the tarsi brown. Wings hyaline, with yellowish veins.

Male.—Much like the female except that the abdomen is much shorter or about as long as wide; face, frons, and a greater part of the cheeks primuline yellow (R.), the postorbital region dark brown, the vertex blackish; legs brighter, purer yellow, the middle femora not

brown as in the female, the hind tibiae hardly darker; the pedicel and flagellum hardly darker than the scape. Length, 1.57 to 1.98 mm.

The following material has been examined: One female (type), Washington City (W. H. Ashmead); two females reared from material of *Porthetria dispar* (Linnaeus), Massachusetts, November, 1894 (C. H. Fernald); one female, Forest Hills, Massachusetts, July, 1911 (C. T. Brues); nine females, six males, reared from *Chrysopa* cocoons, Murray and Salt Lake City, Utah, September 2–18, 1913 (P. H. Timberlake); one female, one male, reared from a *Chrysopa* cocoon, Sacramento, California, August 24, 1912, California State Insectary No. 25; one female reared from material of *Chilocorus similis*, Rossi, Island of Formosa, 1916 (C. P. Clausen); and one female reared from a Hemerobiid, Duarte, California, September 12, 1916 (J. R. Horton), Horton's No. 38.

Type.—Cat. No. 4747, U.S.N.M.

2. ISODROMUS ICERYAE Howard.

Plate 40, fig. 15.

Isodromus iceryae HOWARD, Rep. Ent., U. S. Dept. Agric., for 1886, 1887, p. 488, pl. 3, fig. 1.

Isodromus pulcher GIRAULT, Descriptiones Stellarum Novarum, Washington, D. C., May, 1917, p. 16.

Parataneostigma nigriaxillae GIRAULT, Annals. Ent. Soc. Amer., vol. 8, Oct., 1915, p. 275.

Female.—Head a little thicker than in *niger*, the planes of the frontovertex and face meeting in an angle of but little more than 90°; frontovertex about two and one-half times longer than wide, the dorsal orbits of eyes parallel; ocelli very nearly in an equilateral triangle, the posterior pair about one-fourth of their own diameter from the eye margins, the median ocellus considerably behind the middle of the frontovertex; antennal sockets farther apart than in *niger*, the distance between them being about one and a half times their length, their inner rims nearly parallel; scrobes distinct and reaching above a line drawn between the lower corners of the eyes. Antennae rather shorter than in *niger*, the scape practically the same, the pedicel longer or equal to a little more than the first two funicle joints combined; all the funicle joints wider than long, increasing gradually in width distad, the first joint somewhat smaller than the second and about one-half as wide as the sixth, which is twice as wide as long; club without trace of segmentation, obliquely truncate nearly to the base, and as long as the last four funicle joints combined. Mandibles with three short, equal teeth, the lower two acute, the upper one blunt. Axillae but slightly elevated above the scutellum; the latter rather flat on the basal half, but more sloping towards the sides and apex, the base with a trace of a median impressed line. Wings broad, the basal area with a row of dark-colored cilia next to

the submarginal vein, and an oblique double row or band of similar cilia originating at the bend of the submarginal vein, the speculum indistinct; stigmal vein forming a right angle with the postmarginal vein, and originating distinctly before the submarginal reaches the costal margin; postmarginal vein short and thick at base. Abdomen about two-thirds as long as the thorax, the base broad, the sides nearly parallel, and the apex subtruncate; tactile plates situated but little beyond the middle; the ovipositor barely protruded. Head microscopically and alutaceously punctulate, the frontovertex without pin-punctures, the postorbital region and occiput nearly smooth; mesoscutum very finely reticulate, the axillae and scutellum more coarsely scaly-reticulate, but the reticulations hardly more deeply impressed than on the scutum; the first tergite of abdomen with the reticulations nearly uniform but fading out across the base, otherwise as in *niger*. Pubescence of head very fine and inconspicuous, that of mesoscutum coarser, white and rather prominent but much less so than in *niger;* the scutellum with only a few, hardly visible, dark-colored hairs; the metapleura and hind coxae with the usual, dense, appressed pubescence. Length of body, (1.77 to 2.11); length of head, 0.73; width of head, 0.75; width of vertex, 0.226; length of eye, 0.53; width of eye, 0.38; length of antenna, 1.11; width of mesoscutum, 0.78; length of forewing, 1.94; width of forewing, 0.81; exerted part of ovipositor, 0.06 mm.

General color strontian yellow (R.) but the head often more primuline yellow (R.), the posterior part of mesopleura a little brownish; center of occiput, pronotum except a narrow band along the posterior margin, a lenticular mark on the anterior half of mesoscutum, the axillae, most of scutellum except the apex and often a pale yellowish spot low down on the sides just before the middle, metanotum, propodeum, and most of the dorsum of abdomen except across the base, and a spot on each side just behind the tactile plates black or blackish; most of venter brownish except at base and with a blackish spot on each side near the middle, the exposed part of ovipositor yellowish; tegulae pale yellowish white, with the apical margin broadly brownish. Scape and pedicel uncolorous with face, the funicle pale brown and the club a little darker. Legs strontian yellow, the upper, inner margin of the hind femora on the apical half, the knee joint, a broad annulus just beyond the middle and a narrower one near base of the hind tibiae, and the last joint of all tarsi brownish black. Wings entirely hyaline except for a small brownish area along the lower margin of the stigmal vein, which is hardly wider than the vein itself.

Male.—Entirely similar to the female, but the abdomen is a little smaller, more ovate in shape, and the black spot on each side of venter is nearly absent. Length, 1.66 to 1.85 mm.

Redescribed from the following material which had been compared previously with Howard's type: Three females, two males, reared from a *Chrysopa* cocoon, Pasadena, California, August 7, 1915 (E. J. Branigan), California State Insectary No. 2011; one female collected on *Citrus*, San Diego, California, September 14, 1911 (P. H. Timberlake); and one female, Washington City, January, 1898 (August Busck). Howard[1] also records this species from Kirkwood, Missouri, and Amitilla, Florida, in both cases from *Chrysopa* cocoons. Essig[2] records the rearing of *iceryae* in California from the cocoons of *Sympherobius angustus* Banks.

The type of *I. pulcher* Girault, a female reared from material of *Saissetia oleae* (Bernard), Claremont, California, October, 1909 (C. F. Baker), is mounted on a slide and can not be studied to advantage, but it appears to differ from *iceryae* only in the extension of the yellow coloration. The scutellum is entirely yellow except for a narrow blackish cross-band just before the apex, and the abdomen has more yellow at the base, and the yellow spot at the tactile plates is larger.

The type of *Parataneostigma nigriaxillae* Girault, a female from Mitla, Mexico (L. O. Howard) agrees with the type of *pulcher* except that the cross-band near apex of the scutellum is less distinct.

Types.—Cat. No. 1491 (of *iceryae* Howard), 19339 (of *nigriaxillae* Girault), and 19794 (of *pulcher* Girault), U.S.N.M.

3. ISODROMUS FLAVICEPS (Dalman).

Encyrtus flaviceps DALMAN, Svensk. Vet.-Akad. Handl., vol. 41, 1820, p. 348.
Homalotylus flaviceps MAYR, Verh. zool.-bot. Ges. Wien, vol. 25, 1876, p. 754.
Nobrimus flaviceps THOMSON, Hym. Skand., vol. 4, 1876, p. 140.

This species has not been seen by the writer. It seems to be rare, as the only recorded specimen is Dalman's type, collected by Zetterstedt at Lärketorp, Sweden, about 100 years ago. In coloration, at least, it must be similar to the common North American species, *iceryae* Howard.

4. ISODROMUS AXILLARIS, new species.

Female.—Head hardly longer than wide, not quite so thick frontoccipitally as in *iceryae*, but thicker than in *niger*, the planes of the frontovertex and face meeting in an angle of considerably more than 90°; frontovertex about two and a half times longer than wide, the dorsal orbits of eyes perceptibly but not greatly diverging anteriorly; the ocelli in an equilateral triangle, the posterior pair almost touching the eye margins, and removed twice their own diameter from the occipital margin, the median ocellus considerably behind

[1] Proc. Ent. Soc. Washington, vol. 2, 1891, p. 124.
[2] Inj. and Benef. Ins. Calif., Monthly Bulletin, vol. 2, 1913, p. 151.

the middle of the frontovertex; eyes moderately wide, slightly the widest just before the middle, the facial end rather less bluntly rounded than the occipital end instead of being broadly rounded as in *iceryae;* antennal sockets about as in *iceryae,* the scrobes distinct but not deep and reaching a little above the lower corners of eyes. Antennal scape a little shorter than the eyes, slightly expanded below and widest at the middle, somewhat grooved beneath at apex, and rather strongly curved before the middle; pedicel somewhat longer than the first two funicle joints combined; funicle joints nearly equal in length, the first as long as wide, the following gradually widening so that the sixth is twice as wide as the first; club solid, obliquely truncate to the basal fourth, and nearly as long as the last four funicle joints combined. Mandibles the same as in *iceryae.* Thorax and abdomen also similar except that the ovipositor is rather more protruded. Wings as in *iceryae* except that there are several more rows of cilia on the basal third of disk and the speculum is more distinct. Sculpture as in *iceryae,* although somewhat finer; the pubescence similar. Length of body, 1.70; length of head, 0.61; width of head, 0.60; width of vertex, 0.174; length of eye, 0.44; width of eye, 0.27; length of antenna, 0.95; width of mesoscutum, 0.62; length of forewing, 1.70; width of forewing, 0.66; length of ovipositor, 0.12 mm.

Frontovertex, mesoscutum except behind the parapsidal lines on each posterior corner, and the scutellum pale ochraceous orange (R.), the rest of head, sides, and anterior margin of pronotal collar, posterior corners of mesoscutum and underparts of thorax wax yellow (R.); apex of mandibles, the hidden part of pronotum, the axillae, propodeum, and most of dorsum of abdomen brownish black, collar of pronotum transparent whitish, separated from the blackish area of the concealed part by a narrow yellow band as noted above, and apparently overlying a blackish, concealed area on the anterior margin of mesoscutum; tegulae pale yellowish with the posterior margin brown; metanotum, first tergite of abdomen except median part of the posterior margin, most of the last tergite, ovipositor sheaths and the venter about yellow ocher (R.), the venter a little more brownish towards the apex in the paratype. Scape and pedicel about concolorous with the face, the flagellum pale yellowish brown. Legs wax yellow, the tibiae somewhat darker, or nearly yellow ocher (R.); the middle tibial spur and tarsi a little more whitish, with the apical joint of the tarsi brownish; knee-joint of the hind legs brownish black. Wings entirely hyaline, the veins pale brown.

Male.—Similar to the female, but the yellow parts all about strontian yellow (R.), the frontovertex, mesoscutum, and scutellum concolorous; the scutellum with a pale brownish spot on the disk

just before the apex; the venter of abdomen brownish except at base and on the lateral margins near apex. Length, 1.36 mm.

Described from two females, one male (type, allotype, and paratype), China, probably from one of the southeastern provinces (A. Koebele), Koebele's No. 1553.

Type.—Cat. No. 22045, U.S.N.M.

5. ISODROMUS VINULUS (Dalman).

Plate 41, fig. 17.

Encyrtus vinulus DALMAN, Svensk. Vet.-Akad. Handl., vol. 41, 1820, p. 349.
Homalotylus vinulus MAYR, Verh. zool.-bot. Ges. Wien, vol. 25, 1876, p. 753.
Nobrimus vinulus THOMSON, Hym. Skand., vol. 4, 1876, p. 140.

Female.—Head in general shape very nearly as in *niger*, but the frontovertex broader, being about twice as long as wide, the dorsal orbits of eyes slightly diverging anteriorly; ocelli nearly in an equilateral triangle, the posterior pair almost touching the eye margins, and the median one slightly behind the middle of the frontovertex; antennal sockets situated farther apart than in *niger*, their inner rims strongly convergent above, the distance between their lower corners being about twice their length and between the upper corners about one-half longer again than their length; scrobes faint and hardly reaching a line drawn between the lower corners of the eyes. Antennae considerably longer than in *iceryae* or *niger*, the scape being fully as long as the eyes and the flagellum proportionately as long; scape a little curved near the base, subcylindrical, the inner lower margin slightly expanded, and the underside excavated at apex as usual; pedicel as long as the first two funicle joints combined; funicle joints all nearly equal in length, the first slightly longer than thick, the second and third about as long as thick, and the sixth considerably wider than long and about one-half wider again than the first joint; club solid, obliquely truncate nearly to the base, and as long as the funicle lacking the first and one-half of the second joint. Mandibles with the three teeth rather short and acute, but longer than in *niger* or *iceryae*. Axillae and scutellum practically as in *niger*. Wings unusually narrow, their basal third bare of cilia, the speculum distinct for a short distance and running nearly parallel with the submarginal vein; stigmal vein forming a rather acute angle with the postmarginal and joining the submarginal just before the latter reaches the costal margin; postmarginal vein well developed and nearly one-half as long as the stigmal. Abdomen a little longer than wide and about two-thirds as long as the thorax, the sides subparallel for a short distance, but the base and apex well rounded; tactile plates situated about half way between the middle and the apex, the vibrissae reaching well beyond the apex; the ovipositor barely visible. Head finely punctulate nearly as distinctly as in *niger*, the

pin-punctures few, scattered, and shallow; mesoscutum finely reticulate with the reticulations somewhat lengthened transversely along the anterior margin; reticulations of the axillae and scutellum not much coarser but more deeply impressed than those on the scutum; reticulations on the first tergite of abdomen except across the base fine and uniform and but little coarser than those on the scutum. Head with a very fine and not prominent pubescence, the thorax apparently nearly bare, except for the usual appressed pubescence on the metapleura and hind coxae. Length of body, (2.22 to) 2.26; length of head, 0.73; width of head, 0.73; width of vertex, 0.235; length of eye, 0.49; width of eye, 0.29; length of antenna, 1.29; width of mesoscutum, 0.71; length of fore-wing, 2.00; width of fore-wing, 0.705 mm.

Head auburn (R.), the occiput more blackish, the vertex sometimes along the orbits opposite the median ocellus and the dorsal occipital margin suffused with yellowish; thorax and abdomen nearly black, the mesopleura, however, with a distinct brown tinge; prepectal plates transparent whitish, the collar of pronotum broadly whitish changing to yellowish on the propleura; posterior lateral corners of the mesoscutum primuline yellow (R.) with the anterior margin o the markings convex; tegulae white, with the apical, outer corner fuscous. Antennae nearly uniformly brown, or about bister (R.), the pedicel a little more yellowish, and the base of the scape more nearly concolorous with the face. Front coxae and tarsi, middle coxae, and hind legs blackish brown or about concolorous with the mesopleura; the middle tibiae and tarsi a little paler, especially beneath; front tibiae pale brown, the front and middle femora yellowish brown, and the tibial spur a little more yellowish. Wings with a large brown spot beneath and beyond the stigmal vein, and becoming fainter as it approaches the opposite margin.

Redescribed from two females from Sweden (C. H. Boheman).

6. ISODROMUS ATRIVENTRIS Ashmead.

Plate 41, fig. 16.

Encyrtus puncticeps HOWARD (part), Bull. 5 (old series), Bur. Ent., U. S. Dept. Agric., 1885, p. 14.

Isodromus atriventris ASHMEAD, Proc. U. S. Nat. Mus., vol. 22, 1900, p. 379.

Female.—Head somewhat wider than long, a little thicker frontoccipitally than in *niger;* in side view the facial and dorsal surfaces about equal in length, their planes meeting in a little more than a right angle; the dorsal surface a little less convex than in *niger;* frontovertex nearly two and a half times as long as wide, the ocelli very nearly in an equilateral triangle, the posterior pair almost touching the eye margins, the median one situated a little behind the center of the frontovertex, the dorsal orbits of the eyes very slightly divergent

anteriorly; antennal sockets situated a little farther apart than their own length, their inner rims nearly parallel or only slightly convergent above; scrobes somewhat longer than in *vinulus* and more deeply impressed, reaching to a line drawn between the lower corners of the eyes. Antennae about as long as in *vinulus;* scape as long as the eyes, moderately curved a little below the middle, somewhat thicker distad, and furrowed beneath the apex as usual; pedicel as long as the first two funicle joints; funicle joints about equal in length, except that the third is a trifle longer, increasing a little in width distad, the first three about as long as wide, the last three wider than long, the sixth being about a third wider again than the first; club solid, obliquely truncate to about the basal third, and slightly longer than the last four funicle joints combined. Mandibles with the teeth comparatively long, the lower two acute and the upper one rather blunt. Thorax unusually convex, the axillae well elevated above the scutellum, the latter very high and convex, being rounded from the median line of base toward the sides and apex and abruptly declivous at the margins and without the median impressed line at the base. Wings moderately wide, their basal third bare, the speculum distinct for a short distance and forming a slight angle with the submarginal vein or a right angle with the stigmal vein; the latter a little more curved at the base than in *puncticeps*, forming an acute angle with the postmarginal and joining the marginal at the costal margin; postmarginal vein about a third as long as the stigmal but spurlike. Abdomen about a third longer again than wide, about three-fourths as long as the thorax, broadly oval in shape, both the base and apex being well rounded; the tactile plates situated somewhat less than halfway from the middle to the apex, the vibrissae reaching about to the apex; the ovipositor not protruded. Sculpture very similar to *vinulus*, with the pin-punctures on the head more distinct but not prominent, the reticulations of mesoscutum uniform and those on the first tergite of abdomen a little coarser and very delicately impressed. Face and mesoscutum with a fine, whitish pubescence neither very thick nor prominent, the axillae and scutellum with a more scattered, similar pubescence, the metapleura and hind coxae with the usual appressed hairs. Length of body, (2 to) 2.28; length of head, 0.73; width of head, 0.76; width of vertex, 0.223; length of eye, 0.53; width of eye, 0.33; length of antenna, 1.33; width of mesoscutum, 0.71; length of forewing, 2.10; width of forewing, 0.79 mm.

Frontovertex and mesonotum intermediate between xanthine orange and Mars yellow (R.), the face, cheeks, postorbital region, occiput, and underparts of thorax ochraceous orange (R.); the collar of pronotum nearly transparent or probably whitish in life, the inner half of the axillae more or less blackish, the median part of

the scutellum suffused with dark brown or blackish toward the base; nner half of tegulae white, outer half blackish; the propodeum and metanotum blackish brown, the abdomen entirely black. Scape concolorous with the base, pedicel a little darker, the funicle rather dark brown and the club still darker. Legs ochraceous orange, the front tibiae and tarsi rather dark brown, the hind tibiae and rest of tarsi brownish black, except that the first joint of the middle tarsi is somewhat yellowish; the middle tibiae somewhat brownish above and at the apex, the spur pale yellowish. Wings with a roundish spot beneath the stigmal vein, not extending over halfway across the disk.

Male.—Not known.

Redescribed from one female (type), Ottawa, Quebec (W. H. Harrington); one female (cotype of *Encyrtus puncticeps* Howard), Arlington, Virginia, September, 1881 (L. O. Howard); and one female captured at flowers of *Polygonum*, Melrose Highlands, Massachusetts, September 3, 1909 (P. H. Timberlake).

Type.—Cat. No. 4748, U.S.N.M.

7. ISODROMUS PUNCTICEPS (Howard).

Plate 41, fig. 18.

Encyrtus puncticeps Howard, Bull. 5 (Old Series), Bur. Ent., U. S. Dept. Agric., 1885, p. 14.
Isodromus puncticeps Ashmead, Proc. U. S. Nat. Mus., vol. 22, 1900, p. 379.
Aphycus chrysopae Ashmead, Entom. Amer., vol. 4, 1888, p. 15.
Isodromus chrysopae Howard, Proc. U. S. Nat. Mus., vol. 21, 1898, p. 240.

Female.—Head a little longer than wide, about as thick as in *niger;* the dorsal surface considerably shorter than the facial surface in side view, their planes meeting in an angle of somewhat more than 90°, the dorsal aspect moderately convex or about as in *atriventris;* the frontovertex rather narrow, about three times as long as wide, the ocelli in a somewhat more acute angle than that of an equilateral triangle, the posterior pair close to the eye margins, the anterior one considerably behind the center of the frontovertex, the dorsal orbits of eyes subparallel; antennal sockets situated about one and a half times their own length apart, their inner rims about parallel; the scrobes long, distinct, and reaching well upward between the eyes. Antennae shorter than in *atriventris*, the scape considerably shorter than the eyes, and reaching but little beyond the plane of the frontovertex, subcylindrical, a little thicker at the middle, slightly curved but hardly furrowed at apex beneath; pedicel about equal to the first two together with one-half of the third funicle joint; funicle joints nearly equal in length, the first one slightly longer than thick, the following increasingly wider, the sixth considerably wider than long

and nearly twice as wide as the first joint; club solid, obliquely truncate from apex to basal third, as long as the last four funicle joints combined. Mandibles about as in *atriventris*. Thorax moderately convex, the axillae nearly level with the scutellum, the disk of the latter moderately convex, abruptly rounded and declivous at the sides and apex. Wings very nearly as in *atriventris*, the speculum a little more distinct and nearly parallel with the apical part of the submarginal; the submarginal slightly angulate at the distal fourth and somewhat thicker at the angle; the stigmal vein less curved at base and thinner. Abdomen narrower than thorax and about two-thirds as long, the sides subparallel, the base somewhat narrowed and the apex well rounded; the ovipositor slightly protruded. Sculpture as in *atriventris*, except that the face has finely impressed, fingerprint-like, transverse aciculations, the frontovertex with the pin-punctures more numerous and distinct, and the axillae and scutellum with a much more deeply impressed or roughened sculpture, the surface, therefore, being much less shining; on the axillae the sculpture is subreticulate, but that of the scutellum, on the whole, is more of the fingerprint type, with the aciculations close-set and longitudinally arranged. Face, cheeks and mesoscutum with a whitish pubescence, thicker on the head but more prominent on the thorax; the metapleura and hind coxae with the usual appressed silvery white pubescence. Length of body, 1.91 (to 2.20); length of head, 0.65; width of head, 0.60; width of vertex, 0.159; length of eye, 0.46; width of eye, 0.29; length of antenna, 0.96; width of mesoscutum, 0.585; length of forewing, 1.70; width of forewing, 0.63; length of exserted part of ovipositor, 0.094 mm.

General color intermediate between orange and Mars yellow (R.), the face, cheeks, postorbital region, most of occiput and prothorax, the pleura and base of abdomen often a little paler and more yellowish; mesoscutum in front of the curbed parapsidal lines often darker or about Sudan brown (R.) or becoming even darker medially and anteriorly; collar of pronotum transparent whitish or yellowish along the posterior margin; tegulae white with the apical half pale brown; metanotum, propodeum and most of the dorsum of abdomen brownish black; venter of abdomen like thorax, or sometimes rather dark brown except toward the base and medially; the ovipositor yellow. Antennae concolorous with face, the club and sometimes the funicle rather dark brown. Legs concolorous with pleura or sometimes paler yellow, the front and middle tibiae pale brown, the middle pair sometimes dark brown; hind femora on the upper margin of the inner surface, and the hind tibiae brown to blackish brown; tibial spur yellowish, the tarsi yellowish white with the apical joint dark brown.

Wings with a brownish spot beneath the stigmal vein, becoming fainter as it reaches the opposite margin.

Male.—Not known.

Redescribed from one female (type), Arlington, Virginia, September, 1881 (L. O. Howard); one female (type of *Aphycus chrysopae* Ashmead) reared from a *Chrysopa* cocoon, Jacksonville, Florida (W. H. Ashmead); two females, District of Columbia, one dated August 26, 1890; and one female reared from material of an Aphidid on elm, Yolo County, California (California State Insectary). The latter specimen has darker legs and venter than eastern specimens.

Type.—Cat. No. 2635, U.S.N.M.

BRETHESIA, new genus.

Most closely related to *Isodromus* Howard, but easily recognized by the small eyes, broad frontovertex, and the long face and cheeks. The genus is named after Jean Brèthes, in recognition of his work on South American Hymenoptera.

Female.—Head about as broad as the thorax, rather thin frontoccipitally, thickest and widest at the lower corners of the eyes, subhemispherical in shape with the face slightly inflexed and considerably lengthened or somewhat subrostriform; in side view the planes of the frons and face meet in a very oblique angle, in front view the outline of the upper part of the head well rounded, but from the lower corners of the eyes the cheeks rapidly converge toward the rather narrow oral margin; frontovertex broad or about one-half as wide as the head yet a little longer than wide, and forming with the eyes a strongly convex surface; the large ocelli in an obtuse-angled triangle, the posterior pair a little less than their own diameter from the eye margins and about thrice as far removed from the occipital margin, the median ocellus a little behind the center of the frontovertex; occiput rather deeply concave, the neck inserted near the center, the vertical margin sharp; eyes unusually small as compared with *Isodromus* or *Homalotylus*, their length about one-half more than their width and but little more than the width of the vertex or the length of the cheeks, wider on their anterior half, their long axis about parallel with the plane of the frons, and their dorsal orbits parallel or hardly preceptibly diverging anteriorly; postorbital region rather wide as in *Isodromus* or *Homalotylus;* face strongly convex from side to side, the antennal sockets situated about one-half more than their own length apart and about their own length from the oral margins, their inner rims parallel; the scrobes distinct, forming deep, triangular shaped grooves as wide below as the sockets, but tapering and converging above although not quite meeting; both the

sockets and scrobes separated by a broad ridge well rounded from side to side but entirely plane longitudinally. Antennae short, cylindrical, somewhat clavate, in general structure similar to *Homalotylus* or *Isodromus;* the scape cylindrical, very slightly curved, and excluding the radicle joint about as long as the eyes; pedicel obconical, and a little longer than the first two funicle joints combined; funicle cylindrical but increasing slightly in thickness distad, the first joint unusually short, nearly twice as wide as long, hardly over a third as long as the second and narrower, the next four joints longer than wide, the second and third but slightly so, the fourth about one-third longer than wide, the fifth wider but no longer than the fourth, the sixth hardly longer than wide and about as long as the preceding joint; club considerably wider than the funicle, with three distinct joints, the first of which is shortest, the apical one obliquely truncate from apex to its base on the inner side, the truncation reaching to the middle of the club. Mandibles rather short and very broad at apex with three long, acute, simewhat diverging and incurved teeth of which the middle one is considerably the longest.

Thorax throughout nearly as in *Isodromus,* but not so convex, the mesoscutum, axillæ, and scutellum lying in one plane as in *Homalotylus,* the scutellum flat across the disk, its margins much elevated and abruptly declivous. Legs as in *Homalotylus* or *Isodromus,* the middle tibial spur slender and as long as the first tarsal joint, which is nearly as long as the following joints combined. Fore-wings about as in *Isodromus,* the basal third bare of cilia excepting a row next to the submarginal vein and one obliquely transverse row; speculum distinct, reaching from the stigmal vein obliquely half way across the disk; submarginal vein attaining the margin before the middle of the disk, the marginal punctiform, the stigmal moderately long and very slightly enlarged at apex, the postmarginal about one-third as long and forming an acute angle with the stigmal. Hind-wings as in *Isodromus,* except that the costal cell becomes very attenuated before reaching the hooklets.

Abdomen depressed, broadly ovate in shape, widest at the middle, slightly narrowing toward the base and more rapidly toward the rather acute apex, and a little over one-half as long as the thorax; the tactile plates situated just behind the middle, the vibrissae nearly reaching to the apex; the venter moderately convex from side to side, or as in some specimens the ventrites may be compressed into a sharp longitudinal fold especially toward the base, the fifth ventrite reaching nearly to the apex and enclosing the ovipositor which barely protrudes.

Frontovertex and face rather coarsely, hexagonally punctato-reticulate, with the sculpture delicately impressed; the cheeks, postorbital region and occiput nearly smooth; the mesoscutum microscopically reticulate, the axillae and scutellum with a similar but much coarser reticulation; pleura rather coarsely reticulate, with the aciculations mainly continuous and longitudinal, the prepectal plates, however, scaly-reticulate; abdomen uniformly reticulate except at the apex, and across the base of the first tergite, the reticulations of about the same size as those of the scutellum but more delicately impressed.

Pubescence on face and mesoscutum very fine, rather scattered, whitish in color but not conspicuous; the metapleura concealed by a dense, appressed, silvery white pubescence, the hind coxae with a few scattered hairs of the same character.

Male.—According to Girault's description of [illegible] male is similar structurally, except that the antennae are [illegible] with the funicle filiform, the last five joints being [illegible] half longer than wide.

Type of genus.—*Brethesia latifrons*, new species.

1. BRETHESIA LATIFRONS, new species.

Plate 40, fig. 14.

Female.—Length of body, (1.08 to) 1.21; length of head, 0.45; width of head, 0.39; width of vertex, 0.192; length of eye, 0.244; width of eye, 0.176; length of antenna, 0.705; width of mesoscutum, 0.415; length of forewing, 0.11; width of forewing, 0.42 mm.

Frontovertex and mesoscutum ochraceous orange (R.), the face, cheeks, occiput, and anterior half of underparts of thorax mustard yellow (R.); most of pronotum similar but suffused with pale brownish; axillae and scutellum with an ochraceous orange ground color but suffused with brownish, the apical half of the scutellum becoming still darker brown; metanotum, propodeum, and posterior half of the mesopleura chestnut brown (R.) but appearing more blackish in some lights; tegulae mustard yellow with the apical margin slightly brownish; dorsum of abdomen rather shiny black, with most of the first tergite primuline yellow (R.), a minute dot behind the tactile plates and another at the apex ochraceous orange; venter mostly ochraceous orange but paler medially toward the base, and invaded by the black of the dorsum in two areas on each side, the first pair just before the tactile plates and well separated medially, the second pair just before the apex and nearly meeting, the black marks on each side being narrowly separated by the ochraceous orange, the extension of which produces the dot on the dorsum behind the tactile plates. Antennae nearly concolorous with the face or slightly paler. Legs mustard yellow with the front tibiae on their upper surface and

the front tarsi slightly brownish, the hind coxae and femora paler or about Naples yellow (R.), the hind tibiae blackish brown, the tibial spur and middle and hind tarsi yellowish white, the last joint of the tarsi being tipped with brownish. Wings with a faint brownish spot beneath the stigmal vein, becoming hardly perceptible before reaching the opposite margin.

Male.—Not known.

Described from four females (type and paratypes *a* to *c*) reared from material of *Icerya purchasi* Maskell, Mendoza, Argentina (Carlos Reed). The actual host was perhaps a Chrysopid or Hemerobiid predaceous on the *Icerya*. The specimens are poorly preserved as two of the paratypes have lost the abdomen, and the antennae are missing in all except the type.

Type.—Cat. No. 22046, U.S.N.M.

2. BRETHESIA ABNORMICORNIS (Girault.)

Isodromus abnormicornis GIRAULT, Insec. Insc. Menst., vol. 4, Jan., 1917, p. 118.

This species has not been seen by the writer, but seems to be closely allied to *latifrons*. According to the original description the frontovertex is moderately wide, the second funicle joint subequal to the pedicel, the last funicle joint distinctly wider than long, the propodeum with three widely separated caninae, and the postmarginal vein only somewhat shorter than the stigmal. The coloration is similar, but the pronotum more blackish, the mesopleura entirely black, and the abdomen except at the base solidly black. The types were reared from material of *Icerya brasiliensis* Hempel, Sao Paulo, Brazil (A. Hempel).

Type.—Cat. No. 20606, U.S.N.M.

EXPLANATION OF PLATES.

PLATE 38.

Forewings of female.

FIG. 1. *Homalotylus terminalis californicus.* Salt Lake City, Utah.
2. *H. flaminius.* Cape Town, South Africa.
3. *H. flaminius.* Brisbane, Queensland.
4. *H. flaminius.* Palermo, Sicily.
5. *H. mexicanus.* Guadalajara, Mexico.

PLATE 39.

Forewings of female.

FIG. 6. *H. cockerelli.* Brownsville, Texas.
7. *H. hyperaspidis.* Murray, Utah.
8. *H. affinis.* Uplands, California.
9. *H. quaylei.* Sicily.
10. *H. oculatus.* Manila, Philippine Islands.

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PLATE 40.

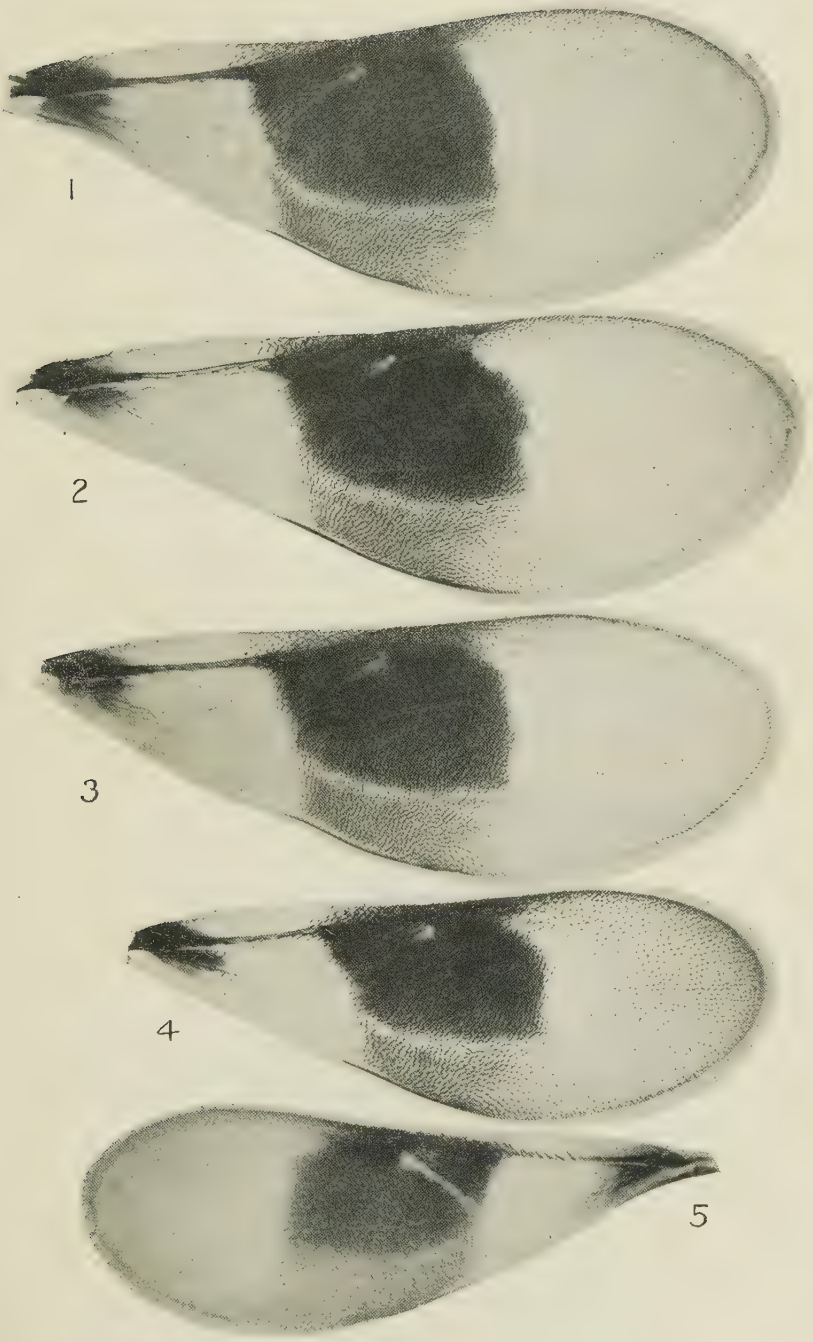
Forewings of female.

FIG. 11. *Anisotylus similis utahensis.* Salt Lake City, Utah.
12. *A. pallentipes.* Oracle, Arizona.
13. *Homalotylus brevicauda.* Ignacio, Mexico.
14. *Brethesia latifrons.* Mendoza, Argentina.
15. *Isodromus iceryae.* San Diego, California.

PLATE 41.

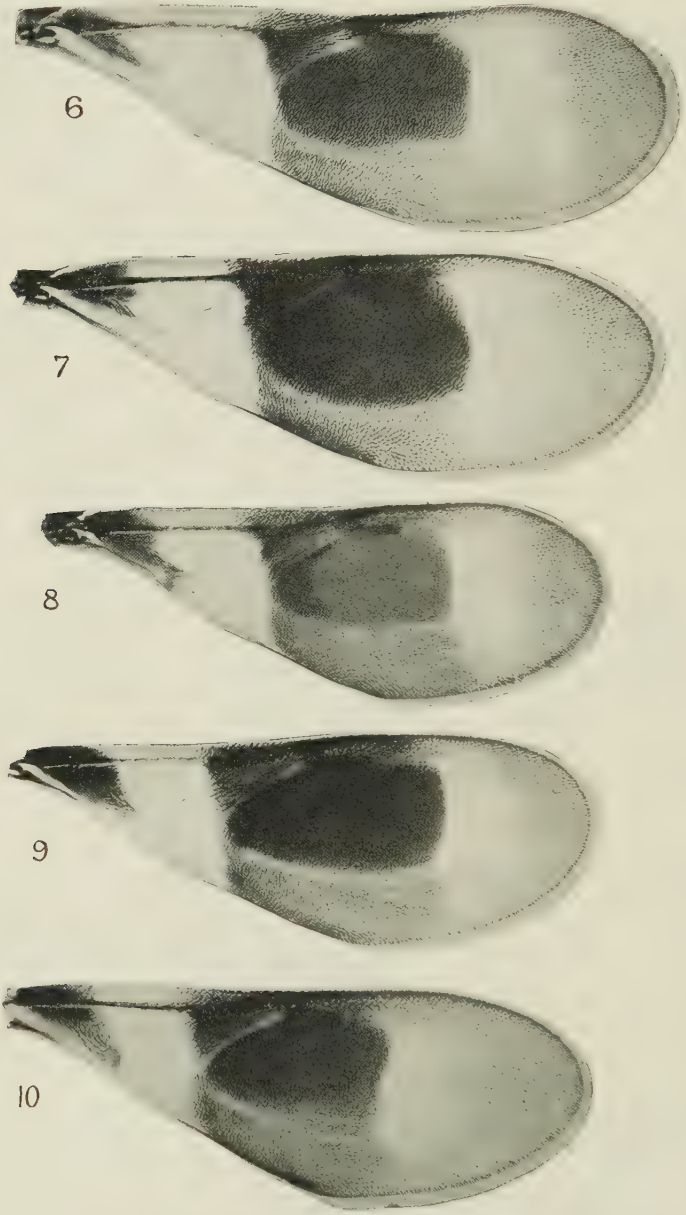
Forewings of female.

FIG. 16. *I. atriventris.* Melrose Highlands, Massachusetts.
17. *I. vinulus.* Sweden.
18. *I. puncticeps.* District of Columbia.
19. *I. niger.* Murray, Utah.



FOREWINGS OF FEMALE PARASITIC CHALCIDOID FLIES

FOR EXPLANATION OF PLATE SEE PAGE 193

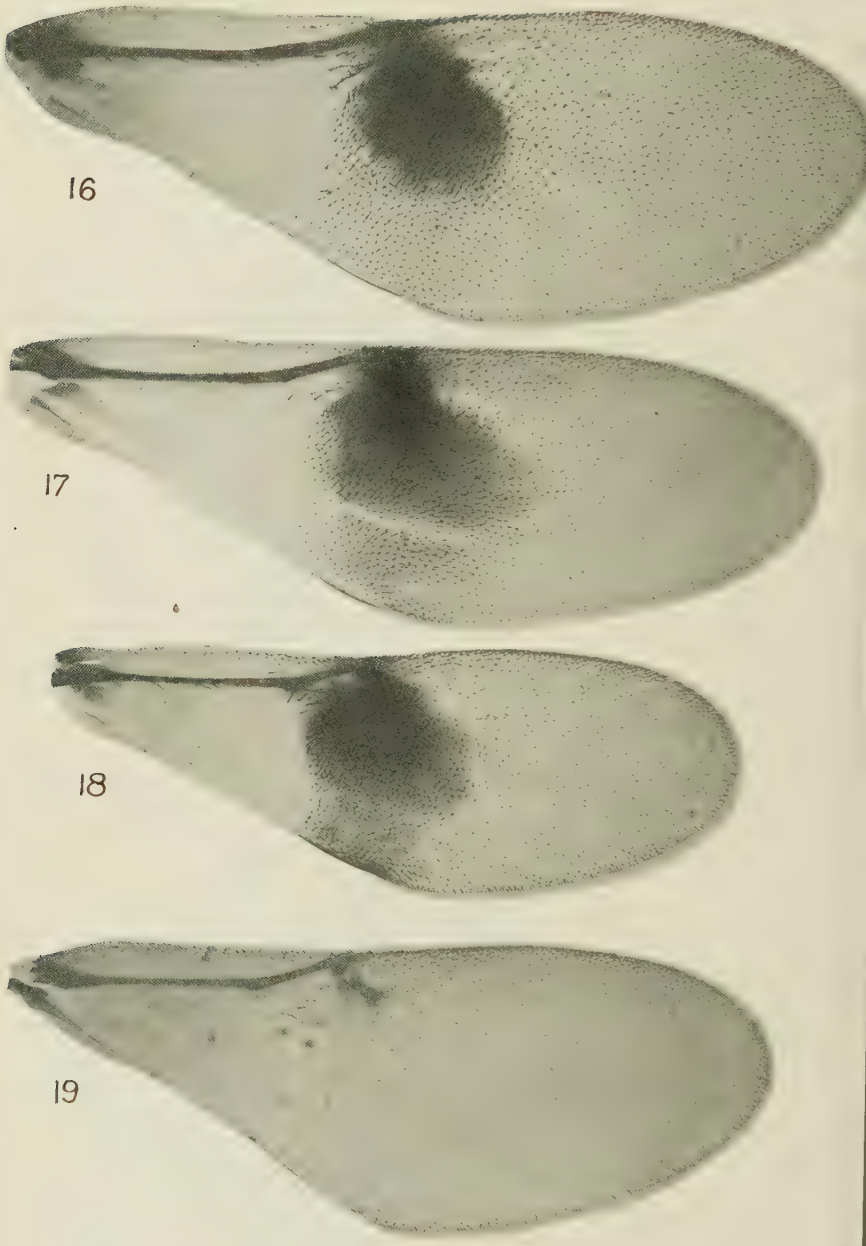


FOREWINGS OF FEMALE PARASITIC CHALCIDOID FLIES

FOR EXPLANATION OF PLATE SEE PAGE 193

FOREWINGS OF FEMALE PARASITIC CHALCIDOID FLIES

FOR EXPLANATION OF PLATE SEE PAGE 194



FOREWINGS OF FEMALE PARASITIC CHALCIDOID FLIES

FOR EXPLANATION OF PLATE SEE PAGE 194

THE FISHES OF THE UNITED STATES ECLIPSE EXPEDITION TO WEST AFRICA.

By Henry W. Fowler,
Of the Academy of Natural Sciences of Philadelphia.

INTRODUCTION.

The collections on which this paper is based are primarily contained in the United States National Museum. The first and most extensive is that obtained by the United States Eclipse Expedition to West Africa in 1889, with William Harvey Brown as naturalist. Collections of fishes were secured by this expedition at the Azores, Cape de Verde Islands, Ascension Island, Sierra Leone, Ashantee, Angola, and Cape Town. An interesting collection was received from Rolla P. Currie and a few specimens from Messrs. O. F. Cook and G. N. Collins, collected in Liberia.

I have further included several small collections from Liberia and the French Kongo, long in the Museum of the Academy of Natural Sciences of Philadelphia. Dr. J. P. Moore sent a few from the French Kongo, from the Biological School of the University of Pennsylvania, and others were sent, through Capt. C. F. Silvester, from Princeton University, obtained in Kamerun. These are all indicated under their respective captions, where reference is given at the beginning of the principal faunal papers.

Five imperfectly-known species are figured, together with the following, which appear to be new:

Julis azorensis.
Abudefduf ascensionis.
Mormyrus goheeni.
Labeo curriei.
Tilapia savagei.
Eutropius eclipsis.
Caranx angolensis.

The types representing these species are all in the United States National Museum. In further explanation of the figures all the new forms are drawn from the types, and the others in the National Museum are:

Belone trachura Valenciennes. 42150.
Liosaccus cutaneus (Günther). 42143.

Chaetodon sanctae-helenae Günther. 42311.

Alticus textilis (Valenciennes). 42318.

The types of *Holopterura plumbea* Cope, and *Syngnathus pellegrini*, new species, are in the Academy, and numbered 22964 and 975, respectively, in the catalogue of that institution.

Acknowledgment is here offered to the authorities of the United States National Museum for the privilege of reporting on their collections, and also to Doctor Moore and Captain Silvester for the loan of their material used in this connection.

DESCRIPTIONS OF SPECIES.

1. Horta, Fayal Island, Azores.

Pereira-Guimaraes mentions fishes from the Azores and Madeira Islands.[1] Hilgendorf published the first comprehensive list[2] and described *Salarias symplocos* as new,[3] afterwards identified as *Blennius galerita* Linnaeus, by Collett, in his report on a small collection.[4] Clark notes a short list of species obtained by the *Scotia* at Horta,[5] and finally Regan has studied an interesting collection.[6]

BELONE TRACHURA Valenciennes.

Head, $2\frac{3}{4}$; depth, $1\frac{1}{5}$, in postocular part of head; D. II, 12; A. II, 17; P. I, 10; V, I, 5; scales along lateral line about 238 to caudal base; 11 scales above lateral line to dorsal origin, and 4 below to anal origin; about 129 predorsal scales to occiput; head width about $1\frac{1}{3}$ in postocular region; eye, 2; interorbital, $1\frac{3}{4}$.

Body elongately fusiform, somewhat pentagonal in transverse section with median dorsal and upper lateral ridges all distinct, greatest depth median. Caudal peduncle broadly depressed, width four-fifths of eye and least depth about $2\frac{3}{4}$.

Head depressed above, flattened sides moderately converge below, so depressed under surface about three-fourths of eye. Snout tip shorter than lower jaw by nearly an eye-diameter, basal width at rictus $7\frac{1}{3}$ its length, surface smooth. Eye ellipsoid, supraorbital cavity slightly bulging upper profile of head. Pupil ellipsoid, large. Maxillary concealed, about reaches eye. Jaws not completely capable of closing basally. Teeth small, largest of upper twice length of lower, none on vomer or palatines. Nasal cavity large, about half size of pupil, triangular, and oblique keel down from its lower

[1] Jorn. Sci. Lisboa, vol. 8, 1883, pp. 30–39 (133); vol. 37, 1884, pp. 11–28.

[2] Arch. Naturgesch., vol. 54, 1888, pp. 205–213.

[3] Sitz. Ges. Naturf. Fr. Berlin, 1888, p. 79.

[4] Arch. Math. Naturv. Christiania, 1897, 19, No. 7, 17 pp. See also Res. Camp. Sci. Prince de Monaco, vol. 10, 1896, pp. 1–198, pls. 1–5.

[5] Scottish Nat. Ant. Exp. Zool., vol. 4, Fishes, 1915, p. 380.

[6] Ann. Mag. Nat. London, ser. 7, vol. 12, 1903, pp. 344–388.

front edge over preorbital. Interorbital broadly concave, supraorbitals with fine striae slightly converging toward occiput, and few low median keels. Postocular space to preopercle edge about seven-eighths of eye.

Gill-opening forward about opposite eye center. Rakers IV + 15, IX, lanceolate, short or about one-third of filaments and latter slightly over half of eye. Isthmus narrow keel.

Scales narrowly imbricated and crowded along sides and lower surfaces, down back medially much larger and broadly exposed. Broadly exposed scales over most of upper surface of head, and extending forward on snout for space equal to $1\frac{2}{3}$ eye-diameters. Fins scaleless, except area converging out over caudal of lateral keels, extension about three-fourths of median rays from bases. Lateral line complete to caudal base, not to latter, and along caudal

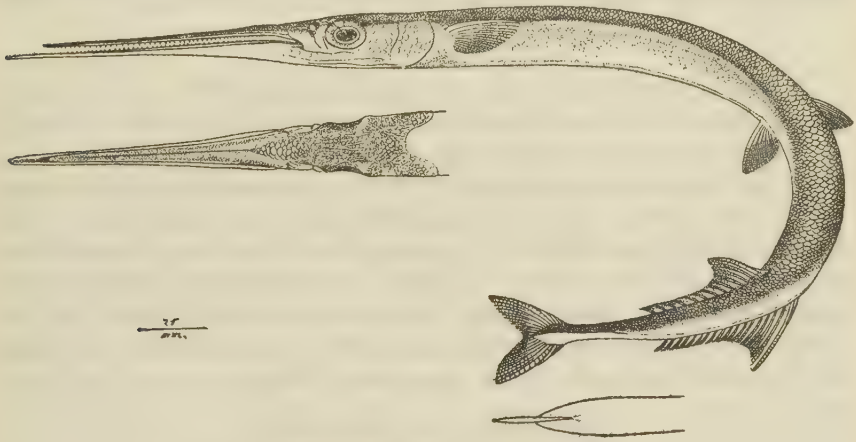


FIG. 1.—BELONE TRACHURA VALENCIENNES.

peduncle behind extends along lower surface of flange or keel. Each tube with several short branches below.

Dorsal inserted slightly behind anal origin, nearly at last third between depressed pectoral tip and caudal base, first branched ray $1\frac{1}{4}$ in postocular region, lobe of fin not quite half of fin length. Anal with large lobe in front, first branched ray about long as postocular region. Caudal (damaged) moderately forked, and lower lobe apparently slightly longer. Ventral inserted about midway between hind preopercle edge and caudal base, fin $1\frac{1}{3}$ in postocular region. Pectoral slightly longer than postocular. Vent nearly three-fifths of eye-diameter before anal.

Color in alcohol deep brown on back and upper surface of head. Along upper side of postocular region, dusky line to end of gill-opening separating silvery-white color of sides and lower surface, but not on trunk. All along edge of dark upper tint, which bounded

on trunk by upper lateral keel, tinge of dark greenish. Iris pale. Fins all pale brownish, with dusky on outer portions.

Length, 450 mm.

Type.—Cat. No. 42150, U.S.N.M.

Also four other examples, showing: head, 3 to 3⅓; depth, 1⅛ to 1¼ in postocular region; D. II, 12, once 11, 14; A. II, 17; scales about 212 to 223 in lateral line to caudal base; about 123 to 135 predorsal scales to occiput; rakers, III to VI+4 to 6 V to XI; eye 1⅔ to 2 in postocular; interorbital 1⅔ to 2; least width of caudal peduncle, 2 to 2⅔; length, 379 to 429 mm.

My examples differ from the accounts by Valenciennes[1] and Günther[2] in the constantly fewer anal rays, or 19 instead of 20 to 21, partly pentagonal body, slightly more advanced ventral and apparently larger scales. In structure the scales show the circuli complete, very fine, or simply convergent.

SCOMBER COLIAS Gmelin.

Head, 3⅝ to 3¾; depth, 5⅛ to 6¼; D. X—II, 10+5; A. III, 10+5; snout, 2¾ to 3 in head measured from upper jaw tip; eye, 4⅛ to 4⅓; maxillary, 2⅝ to 2¾; interorbital, 4 to 4½; second dorsal spine, 2 to 2 1/10; first branched dorsal ray, 4⅛ to 4⅜; pectoral, 2¼ to 2⅓; ventral, 2⅝ to 2½; rakers, 16+30. Maxillary about to eye front. Front nostril about three-fifths of eye-diameter before eye. Interorbital flattened. Spinous dorsal inserted about midway between hind nostril and soft dorsal origin. Pectoral about one-fourth to one-third in depressed spinous dorsal. Ventral inserted near first third of depressed pectoral. Two examples, 229 mm.

TRACHURUS PICTURATUS (Bowdich).

Head, 3¼ to 3½; depth, 4½ to 5½; D. VIII—I, 30 to 34; A. II—I, 25 to 29; scutes in lateral line, 49 to 56+45 to 52, and of latter usually 4 to 8 on caudal base; snout, 3 to 3⅓ in head measured from upper jaw tip; eye, 3 to 3⅜; maxillary, 2⅝ to 2½; interorbital, 3⅝ to 4; rakers, 16 or 17+39 to 41; length, 132 to 205 mm. Fourteen examples.

Trachurus trachurus (Linnaeus), of the Mediterranean, is close to the present species in the broad scutes in the first half of the lateral line, apparently differing in their fewer number, 79 to 86, compared with 94 to 108 in *T. picturatus*. Both species have far more scutes than *T. semispinosus* (Nilsson) in which they are said to be 70 to 75. Compared with examples from California (San Pedro and Santa Catalina) of *T. symmetricus* the present form shows several striking differences. It has the lateral line much wider, as width of upper two-thirds and lower three-fifths of eye, compared with width of upper one-half and lower two-thirds in eye in *T.*

[1] Hist. Nat. Poiss., vol. 18, 1846, p. 339. [2] Cat. Fish. Brit. Mus., vol. 6, 1866, p. 235.

symmetricus. The eye is much larger in *T. picturatus* and the pectoral is also slightly longer. The scutes are within the same variable limits in both species, my Californian material showing 50 to 54+46 to 52, though with rakers apparently slightly more numerous, 16+45. The example I recorded from Valparaiso,as the present species is *T. symmetricus*.[1] It has scutes 50+50.

Scales of all three species are variable, though usually with three basal striae more or less marginal. The circuli are fine, but little coarser on middle of scale.

The Australian *Caranx declivis* Jenyns[2] is shown with broad scutes as in *T. picturatus*, 82 in number, with about 50 on drawing as spinescent in straight part of lateral line, though it has a few more soft dorsal and anal rays than any of my examples of *T. picturatus*. Bowdich originally published a wretched figure and his description says soft dorsal with 17 and anal with 15 rays.[3]

CAESIOMORUS GLAUCUS (Linnaeus).

Head, 3⅞ to 4; depth, 2½ to 2⅝; D. VI—I, 1, 25, once 24; A. II—I, 1, 23 to 25; snout, 3½ to 3¾ in head; eye, 4 to 4⅜; maxillary, 2⅝ to 2¾; interorbital, 2⅞ to 3; scales, 127 in lateral line to caudal base and 4 more on latter. Body well compressed, contour evenly fusiform. Caudal peduncle compressed, depth ½ to ⅝ its length. Predorsal keel forward till over nostrils. Head compressed, sides about evenly approximate above and below. Snout conic, long as wide or length four-fifths of width. Eye round, advanced, hind edge midway in head length and adipose lid around edges. Maxillary slightly beyond eye front, expansion 2½ to 2⅝ in eye. Mouth oblique, jaws about even. Teeth minute, in narrow bands, resolving into 1 or 2 irregular narrow rows along sides of jaws. Narrow band of very minute teeth, and similar ones in small arrow-shaped line on vomer. Nostrils small, together, about two-thirds of eye diameter before eye and level with its upper edge. Least infraorbital width slightly over one-fourth to one-third of eye. Rakers 14 to 16+28 to 31, lanceolate, slightly longer than filaments. Scales cycloid, rounded, largest along lateral line opposite soft dorsal and anal. Patch of scales on front of cheeks behind maxillary, and another behind eye, head otherwise naked. Spinous dorsal begins little nearer soft dorsal origin than hind eye edge, spines low, second to fourth subequally longest or about 1⅝ to 1¾ in eye. Soft dorsal inserted about midway between snout tip and eye, or little nearer caudal base, front of fin elevated though not as lobe and first branched ray 1¾ to 1⅞ in head. Soft anal similar, only first branched ray 1¾ to 2⅛ in head. Caudal very deeply forked, long slender pointed

[1] Copeia, No. 34, Aug. 24, 1916, p. 64.

[2] Zool. Voy. *Beagle*, Fishes, 1842, p. 68, pl. 14.

[3] Excurs. Madeira, 1825, p. 123, pl. fig. 27.

lobes about equal, 2¾ to 2⅘ in combined head and trunk. Pectoral short, pointed, 1⅘ in head. Ventral inserted slightly before spinous dorsal, 1⅗ to 2½ in pectoral. Color in alcohol with silvery-white reflections, back dusky with dark bluish tint, lower surfaces whitish. Fins largely dull brown, dorsal and anal front tips black. Each caudal lobe largely dusky above and below, leaving hind edge broadly paler. Pectoral axil dusky, fin like ventral, with somewhat yellowish-brown tint. Six examples, 163 to 334 mm.

These agree with a series of 19 Italian examples of all ages. Rakers and scales fewer in young than in adults, and scale structure identical in all.

SERRANELLUS ATRICAUDA (Günther).

Head, 2⅔; depth, 3⅓ to 3½; D. X, 15, 1; A. III, 8, 1; scales along and just above lateral line to caudal base, 120 to 126 and 12(?) to 18 on latter; pores in lateral line 73 to 80 to caudal base and 3 or 4 more on latter; 10 scales above lateral line, 28 to 30 below; predorsal scales 28 to 34; snout 3⅖ to 3⅔ in head measured from upper jaw tip; eye, 5 to 5⅔; maxillary, 2⅕ to 2¼; interorbital, 5⅔ to 6¾. Body compressed, rather fusiform. Head well compressed. Snout about broad as long. Eye advanced, hind edge about midway in head length. Maxillary to eye center, expansion 1⅘ in eye. Mouth large, lower jaw slightly projecting. Strong canines in front of jaws and along mandible sides. Nostrils close, front one nearly half an eye-diameter before eye. Interorbital flattened. Preopercle edge finely serrated, serrae but slightly coarser below. Rakers, v 3 +11 II or III, lanceolate, long as filaments, or 2⅕ in eye. Pseudobranchiae about ⅔ of gill-filaments. Scales finely ciliated, with 6 to 12 basal striae. Cheek with 18 rows of scales. Muzzle, interorbital, preorbital and top of head naked. Fourth dorsal spine longest, 2⅔ to 3 in head. Soft dorsal inserted little nearer caudal base than eye, front rays little longer, second ray 2⅖ to 2⅔ in head. Third anal spine longest, 3½ in head. Soft anal like soft dorsal, third ray 2⅓ in head. Caudal slightly emarginate, upper lobe little longer. Color in alcohol generally dark brownish. Below lateral line along sides row of 4 or 5 large square dusky-brown blotches and streaks of same color between each. Above lateral line color largely dark brown. Pale blue oblique line along upper maxillary edge or impression. Another parallel from below eye front to cheek corner. Dusky spot below eye front and on cheek at end of maxillary. Fins brownish, edges of unpaired blackish. Upper and lower corners of caudal and anal end black. Soft dorsal, anal, caudal and caudal peduncle rather sparsely marked with small bluish dots. Pectoral pale brown. Ventral with dusky shade. Iris brown. Three examples, 170 to 245 mm.

BOOPS BOOPS (Linnaeus).

Head, $3\frac{3}{5}$ to $3\frac{5}{6}$; depth, $3\frac{5}{6}$ to $4\frac{2}{5}$; D. XIV, once XIII, 14, once 13; A. III, 15, once 16; scales 72 to 80 in lateral line to caudal base, and 5 or 6 more on latter; 5 to 7 scales above lateral line and 12 to 14 below; 20 to 24 predorsal scales; snout $3\frac{1}{3}$ to $4\frac{4}{5}$ in head; eye $2\frac{7}{8}$ to $3\frac{1}{3}$; maxillary $3\frac{1}{2}$ to 4; interorbital, $2\frac{7}{8}$ to $3\frac{1}{5}$; rakers, 7+18 to 20, lanceolate, two-thirds to little less than filaments and latter about half of eye. Seven examples, 85 to 207 mm.

These agree with a series of Mediterranean examples in the Academy, though some of the latter vary greatly in depth. The scales of all show about 10 to 12 basal striae.

PAGELLUS CENTRODONTUS (Delaroche).

Head, 3; depth, 3; D. XII, 10 or 11; A. III, 12; scales 75 to 78 in lateral line to caudal base and 6 to 8 more on latter; 6 or 7 scales above lateral line, 16 or 17 below; snout, $3\frac{2}{5}$ to $3\frac{1}{2}$ in head; eye, 3; maxillary, 3; interorbital, $3\frac{3}{5}$ to 4; rakers, 13+19, lanceolate, about long as filaments, which 2 in eye; 7 scales on cheek. Two examples, 98 to 108 mm.

Compared with a Mediterranean example 130 mm. long, scales of all finely ciliated and with 6 to 10 basal striae. None of the other Mediterranean examples, long in alcohol, show the dark shoulder blotch distinct, and only a slight trace in the Horta examples.

PAGELLUS ACARNE (Risso).

Head, $3\frac{1}{8}$ to $3\frac{1}{6}$; depth, 3; D. XII, 10 or 11; A. III, 10; scales, 70 to 72 in lateral line to caudal base and 6 or 7 more on latter. Body fusiform, elongate, moderately compressed. Head well compressed, sides flattened. Snout about wide as long. Eye large, slightly advanced, long as snout or $3\frac{1}{2}$ in head. Mouth little inclined, lower jaw shorter. Maxillary reaches slightly beyond eye front, not quite to pupil. Front teeth fine and conic, and hind teeth two rows of molars above and below. Front nostril pore about two-fifths of eye before same, and hind nostril large slit close behind. Interorbital broadly convex, wide as eye. Preorbital depth $1\frac{3}{5}$ its length. Preopercle edge entire. Rakers, 10+13, lanceolate, nearly equal filaments or $2\frac{1}{3}$ in eye. Pseudobranchiae long as gill-filaments. Squamation very compact, scales narrowly imbricated, each with 9 or 10 basal radii, latter rather obsolete with age. Suprascapula edge little jagged. Most of caudal covered with minute scales. Lateral line nearly concurrent with dorsal profile, elevated along side of caudal peduncle. Cheek with five rows of scales. Dorsal spines pungent, slender. Soft dorsal inserted about midway between spinous dorsal origin and caudal base, front rays little elevated. Anal similar, spines slender and third longest.

Caudal forked. Pectoral not quite to anal, long as head. Ventral spine, $1\frac{2}{3}$ of fin, latter $1\frac{1}{2}$ in pectoral. Color in alcohol uniform brownish, sides and below with traces of silvery white. Dorsal tinted, with dull brown. Pectoral axil and base with large dusky-brown blotch. Two examples, 189 to 241 mm.

PAGRUS PAGRUS (Linnaeus).

Head, $3\frac{1}{5}$; depth, $2\frac{3}{5}$; D. XII, 10, 1; A. III, 8, 1; scales, 53 in lateral line to caudal base and 9 more on latter; 7 scales above lateral line, 15 below; snout, $2\frac{1}{2}$ in head; eye, $3\frac{3}{4}$; maxillary, $2\frac{4}{5}$; interorbital, $3\frac{1}{4}$. Body oblong, well compressed, upper profile evenly convex from snout tip to soft dorsal. Head well compressed, sides flattened. Snout, width $1\frac{1}{2}$ its length. Eye large, midway in head length. Maxillary about to eye. Molar teeth biserial. Pair of small canines in front of each jaw behind which patch of villiform teeth. Front nostril about half an eye-diameter before eye. Interorbital convex. Preorbital width equals eye. Rakers, 8+9, short stumps about one quarter of filaments, latter $1\frac{2}{3}$ in eye. Pseudobranchiae large as gill-filaments. Scales narrowly imbricated, about 11 basal striae on largest. Cheek with seven rows of scales. Suprascapula edge nearly entire. Scales very small on top of head, below suprascapula, on pectoral and caudal bases, and along soft dorsal and anal bases. Tubes in lateral line simple, largely concurrent with dorsal profile and little high along caudal peduncle side. Dorsal spines rather slender. Soft dorsal inserted about midway between spinous dorsal origin and caudal base, fin low. Anal similar, second and third spines subequally longest. Caudal deeply forked. Pectoral little longer than head, reaches second anal spine base. Ventral spine $\frac{3}{4}$ of fin, fin $1\frac{3}{5}$ in pectoral. Color in alcohol, dull uniform brownish generally, with traces of bright silvery-white on sides and below. Length, 241 mm.

DIPLODUS SARGUS (Linnaeus).

Head, 3 to $3\frac{1}{5}$; depth, $1\frac{7}{8}$ to $2\frac{1}{4}$; D. XII, 13,1, or 14, 1; A. III, 13 1, or 14, 1; scales 60 to 65 in lateral line to caudal base, and 6 to 8 more on latter; 8 or 9 scales above and 16 to 18 below lateral line; snout, $2\frac{2}{5}$ to 3 in head; eye, $2\frac{4}{5}$ to $4\frac{1}{5}$; maxillary, 3; interorbital, $2\frac{7}{8}$ to $3\frac{1}{4}$; rakers, 7 or 8+9 or 10. Three examples, 70 to 260 mm.

One of the above from Loando, Angola (p. 284). It has three rows of molars above and two below and slightly larger and longer anal spines than the largest example, from the Azores. In the last axilla and hind edge of opercle flap dusky and preorbital, about seven-eighths of eye. In young axilla and opercle flap pale, preorbital but slightly over half of eye, and molars in three rows above and two below. Young in alcohol with back olive, grayish where scales have fallen, with six vertical lines or narrow bands of deeper

olive-brown down to abdomen, also dark or slaty blotch on front of caudal peduncle. Fins, pale brownish, ends of ventrals and median caudal rays dusky. Head, iris, and sides with silvery reflections.

An example from Messina, Italy, agrees best with the largest of the above. It has the dark axillary blotch, though shorter pectoral. Rakers, 8+10; length, 216 mm. The scales of all the examples alike, finely ciliated, and with many as 9 basal striae.

CHROMIS CHROMIS (Linnaeus).

Head, $3\frac{1}{5}$; depth, 2; D. XIV, 11; A. II, 11; scales, 19 in upper arch of lateral line and 11 pores in straight section before caudal base; 4 scales above lateral line to spinous dorsal origin, 10 below to spinous anal origin; 27 predorsal scales; snout, $3\frac{3}{4}$ in head; eye $3\frac{1}{6}$; maxillary, 3; interorbital, $2\frac{3}{4}$. Body greatly compressed, elongately ellipsoid. Caudal peduncle compressed, length two-thirds least depth, which two in head. Last with flattened sides, width $1\frac{3}{5}$ its length. Snout, convex; length, about $\frac{3}{4}$ its width. Eye large, rounded, advanced, hind edge little behind middle in head length. Mouth small, inclined but little from vertical, lower jaw slightly protruding. Lips rather fleshy. Maxillary almost to eye, expansion $2\frac{2}{5}$ in same. Teeth conic, outer row slightly enlarged, in narrow bands in jaws. Nostril simple pore near last fourth in snout. Interorbital convex. Preorbital narrow, 3 in eye, edge entire, also preopercle edge. Rakers, 10+21, lanceolate, slender, equal filaments, or $2\frac{1}{5}$ in eye. Scales large, finely ciliated, with 7 or 8 basal striae, of smaller size about bony edges and top of head. Preorbital with two irregular rows of scales and four rows on cheek. Very small scales on fins basally. Lateral line with upper arch only to soft dorsal origin, tubes simple. Spinous dorsal inserted behind pectoral origin or about opposite ventral origin; fourth spine longest or slightly less than half of head. Soft dorsal greatly posterior, behind soft anal origin and third or longest ray forming fin point, $1\frac{2}{3}$ in head. Second anal spine much longer than first, $1\frac{7}{8}$ in head; fin origin little nearer caudal base than pectoral origin. Soft anal larger than soft dorsal, pointed behind with seventh ray longest or $1\frac{2}{5}$ in head. Caudal elongate, deeply forked, long lobes sharp pointed, longer than head by eye-diameter. Pectoral pointed, long as head. Ventral reaches anal, first ray filamentous, spine half of fin. Vent half an eye-diameter before anal. Color in alcohol dull uniform brownish with slight olive tint; back and head above, dusky. Spinous dorsal, front half of soft dorsal, first two-thirds of soft anal and outer halves of each caudal lobe black. Remaining portions of soft dorsal and anal, and caudal, whitish. Pectoral pale, also ventral, though latter with front edge and base brownish. Iris brown. Length, 140 mm.

JULIS AZORENSIS, new species.

Head, $3\frac{1}{3}$ (without teeth); depth, $4\frac{2}{3}$; D. IX, 12, 1; A. III, 12; P. II, 12; V. I, 5; scales, 60+10 in lateral line to caudal base, and 8 more on latter; 4 scales above lateral line to soft dorsal origin; 20 below to spinous anal origin; 16 predorsal scales; head width, $2\frac{1}{2}$ its length; snout, $3\frac{2}{5}$; eye, $5\frac{1}{2}$; maxilliary, $4\frac{1}{4}$; interorbital, 5; second dorsal spine, $4\frac{2}{3}$; first dorsal ray, $2\frac{2}{3}$; second anal ray, $2\frac{1}{2}$; caudal, $1\frac{2}{3}$; pectoral, $1\frac{1}{2}$; ventral, $2\frac{1}{3}$.

Body much elongated, well compressed, deepest at hind opercle edge and tapering gradually back to caudal, edges convex. Caudal peduncle strongly compressed, about long as deep and least depth about $2\frac{1}{2}$ in head.

Head elongately rhomboid, well compressed, sides slightly flattened and about evenly approximate above and below. Snout conic, upper profile slightly concave in front; width, $1\frac{1}{4}$ its length. Eye rounded, advanced, with hind edge little before center in head

FIG. 2.—JULIS AZORENSIS.

length. Mouth moderate, gape extending about halfway to eye; jaws and teeth about even in front. Maxillary about reaches opposite front nostril. Lips moderately wide, fleshy. Teeth biserial, outer row much larger, and four canines in front of each jaw, of which median pair of each much larger. Tongue small, elongate, end free and rounded. Nostrils small, near one another; front one about half an eye-diameter before eye. Interorbital convex. Least width of preorbital about seven-eighths of eye. Hind preopercle edge entire.

Gill-opening forward about opposite hind pupil edge. Rakers 8+11 short flexible points, spinescent, about one-fourth of filaments, and latter two-fifths of eye. Isthmus triangular, with median keel.

Scales thin, in even longitudinal rows, elongate, well exposed, cycloid. Head naked. Scales smaller on predorsal, breast, and caudal base. Scales with about 18 basal radii and twice as many apical obscurely, circuli very fine. Lateral line complete, high along

back at first, then drops just before caudal peduncle until midway on side and extends out on caudal base. Tubes largely simple, well exposed.

Spinous dorsal inserted well before hind opercle edge, about over pectoral origin; spines more or less subequal, and first not elongated. Soft dorsal inserted about midway between front eye edge and caudal base; fin of about uniform height, and edge like that of spinous dorsal, slightly notched. Anal inserted opposite soft dorsal origin, with weak spines of which third longest and rayed fin like soft dorsal. Caudal oblong, truncate behind. Pectoral pointed from upper rays, which longest, reaches three-fourths to anal. Ventral origin very slightly before pectoral origin, fin half way to anal and spine two-thirds of fin. Vent close before anal.

Color in alcohol largely brown above on back and head. Paler below with tinge of buff. Dark color of back not strongly contrasted with paler lower colors. Well-defined dark line from pectoral axil to caudal base little below middle. Cheek and opercles brown above. Small black spot less than pupil on opercle flap near tip above, also another at pectoral origin. Membrane between first two dorsal spines deep brownish, and entire dorsal fins otherwise pale or dull buff. Other fins buff. Iris brassy-yellow. Length, 170 mm.

Type.—No. 42127, U.S.N.M. Horta, Fayal Island, Azores, November 3, 1889. Wm. Harvey Brown.

Only the above unique example, allied with *Julis atlantica* (Günther)[1] in its uniform spinous dorsal and slender body. In these points it differs strikingly from Mediterranean examples of *Julis julis* (Linnaeus) before me. From Günther's species it may easily be distinguished by its shorter ventrals and coloration. Günther describes two broad dark longitudinal bands, one along the back and the other from the pectoral to the caudal base medially, a black spot at the end of the opercle, dorsal, and anal each narrowly edged blackish with broad violet band along middle, caudal corners dark, ventral filaments blackish and no black axillary blotch. Its size is not given.

I have compared *Julis giofredi* (Risso), from the Mediterranean, and find it allied in the uniform spinous dorsal, though differing in the much smaller inconspicuous axillary black spot, which a mere speck in most. It is not even indicated by Bonaparte[2] and Valenciennes.[3] The lower band on the side extends from the head below to the pectoral base and the caudal base, in *J. giofredi*, and said to be yellow in life, though evidently all faded in my Italian and Mediterranean examples. They show only a whitish parallel line between

[1] Cat. Fish. Brit. Mus., vol. 4, 1862, p. 197. Sierra Leone.
[2] Fauna Italica, Pesc., vol. 2, 1841 (117) fasc. 30, pl. 2.
[3] Hist. Nat. Pois., vol. 13, 1839, p. 271.

it and dark color on back, latter bounded by a dark band from snout to median caudal base.

(For the Azores where the type was obtained.)

BALISTES VETULA Linnaeus.

One example, 305 mm. to caudal base, 535 mm. to end of caudal filaments.

LACTOPHRYS NOTACANTHUS (Bleeker).

Head, $2\frac{1}{2}$; depth, $2\frac{1}{8}$; D. I, 9; A. I, 9; eye, 3 in snout; snout, $1\frac{1}{4}$ in head to upper angle of gill-opening; interorbital, $2\frac{1}{2}$; caudal, $1\frac{1}{4}$. Preocular spine slightly over half of eye. Median keel of back with distinct small spine at last third between hind eye edge and dorsal origin. Caudal peduncle unarmed. Color in alcohol with each scute with submarginal ring and central spot of darker brown than body color, all of which, somewhat variable at ring, may be waved slightly in places and central spot appear as if formed of several blotches. Length, 266 mm.

Apparently distinct from the West Indian *Lactophrys tricornis* (Linnaeus), none of my examples having the erect dorsal spine before the dorsal fin as in the above. Bleeker's species is without the bridges behind dorsal and anal fins, where each edge ends in a backwardly directed spine. Günther admits it [1] only as a variety and says "examples from the West Indies with an indication of the dorsal spine are by no means uncommon."

LIOSACCUS CUTANEUS (Günther).

Head, $2\frac{2}{3}$; depth (contracted), about $3\frac{1}{2}$; D. II, 6; A. II, 6; P. I, 14; head width, $1\frac{2}{3}$ in its length; snout, $1\frac{4}{5}$; eye, $4\frac{3}{4}$; interorbital, $2\frac{4}{5}$. Body cylindrical, robust; belly loose, though skin tough or moderately pliable and capable of great inflation. Caudal peduncle depressed so least depth equals its width at same point. Head large, robust, broad as deep when not inflated, upper profile little inclined in front. Snout convex over surface and in profile, about wide as long. Eye moderate, ellipsoid, front edge about midway in head. Mouth rather large. Teeth large, with entire even cutting edges. Lips thick, fleshy, and greatly papillose. Nostrils together, on front and hind faces of short fleshy knob, which is nearly an eye-diameter in advance of eye, nearly level with upper edge. Interorbital broad, with wide shallow median concavity. Gill-opening nearly vertical, equals $1\frac{1}{3}$ eye-diameters. Skin entirely smooth, with very fine longitudinal wrinkles on back and sides behind pectoral to dorsal and on inflatable belly. Dorsal inserted nearly at last third between front eye edge and caudal base. Anal similar, inserted entirely but close

[1] Cat. Fish Brit. Mus., vol. 8, 1870, p. 258.

behind dorsal. Caudal with hind edge slightly concave. Pectoral broad, upper rays forming slight point above and rounded lobe below, larger than dorsal. Color in alcohol uniform brown above, under surface same general tint except paler. Iris pale olive-brown. Dark blotch over each eye on interorbital edge. Fins dull brownish. Length, 248 mm.

The above interesting example appears identical with *Tetrodon cutaneus* Günther.[1] Its distribution so far to the northward as the Azores is likely due to the influence of the Guinea Current. In Günther's short description few other than minor variants appear, so that I am unable to separate the Azores fish from the South Atlantic.

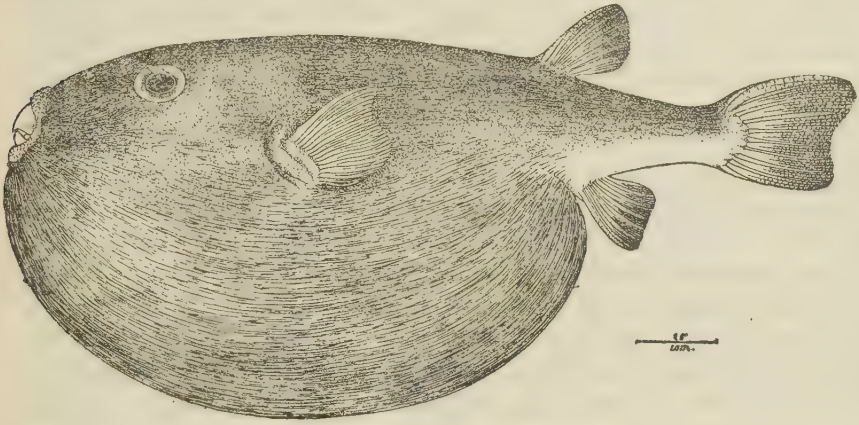


FIG. 3.—LIOSACCUS CUTANEUS (GÜNTHER).

2. PORTO GRANDE ON ST. VINCENT, CAPE DE VERDE ISLANDS.

The Cape de Verde Islands partake largely of the African ichthyfauna, and, lying along the route of European exploration and discovery of the West African region, are associated with its development. As Gorec Island, off the Senegal, was the first point on the African coast from which any attempt was made to gather representative collections of fishes, one finds the first enumeration of Cape de Verde fishes, with those from the Gabun, also included in Duméril's memoir "Poissons Afrique Occidentale." [2] Brito-Capello gives a list of the fishes obtained in the various Portuguese possessions,[3] among them a number from the Cape de Verde Islands. Other localities are Angola, Madeira, St. Thomé, Baissau, and Mozambique. Pereira-Guimaraes, in the papers already referred to under the Azores collection, also mentions species from the Cape de Verde Islands. Günther has a short list in his *Challenger* shore fishes from St. Vincent

[1] Cat. Fish. Brit. Mus., 1870, p. 287.
[2] Arch. Mus. Hist. Nat., vol. 9, 1858, pp. 241–268, pls. 20–23.
[3] Jorn. Sci. Lisboa, 1871, pp. 194–202, 208 307; 1872, p. 83.

and St. Jago,[1] and Clark lists those obtained by the *Scotia*.[2] Detailed accounts and figures of a Goree collection are given by Steindachner.[3]

SARDINELLA AURITA (Valenciennes).

Two examples.

MURAENA MELANOTIS (Kaup).

Head, 8; depth, 12½; combined head and trunk shorter than rest of body by space between eye and gill-opening; snout, 6 in head measured from upper jaw tip; interorbital, 7¼; upper jaw to rictus, 2½; eye, 2⅘ in snout, 2½ in interorbital. Snout length, about 1¼ its width. Lower jaw well protruded. Teeth uniserial, strongly compressed, entire. Two fang-like teeth in front above, hind one larger. Nostrils in short tubes of about equal length, three in eye, posterior slightly before eye. Anal edge inconspicuously and narrowly pale brown. General color dark chocolate brown with largely uniform appearance. Length, 1,373 mm.

This example does not show the short dark vertical lines forming squares on front part of body above, as indicated in Kaup's figure of *Limamuraena melanotis*,[4] though the characteristic black rictal blotch and much larger one embracing the gill-opening quite conspicuous. The tail and trunk also show traces of obscure dark blotches or spots, and along dorsal fin several distinct blackish blotches. *Muraena clepsydra* Jordan and Evermann differs in color and has a much shorter lower jaw, the black rictal blotch with white blotch immediately forward and anal edge not pale.

GYMNOTHORAX FUNEBRIS (Ranzani).

One example, 950 mm. Edge of anal very narrowly pale. Compared with an example from Santo Domingo, West Indies, it largely agrees, except in its more olive-brown tinge. Bloch's figure of *G. afer*[5] shows a moray with well blotched or deeper dark markings and is closely related to *Muraena moringua* Cuvier, as contended by Jordan and Davis.[6]

ABLENNES HIANS (Valenciennes).

One 760 mm. (jaws damaged). Compared with a slightly smaller example from St. Christopher's Island, West Indies, which measures 384 mm. (beak broken), the scales are different, due to age. In the West Indian fish the circuli are all more or less united, and with the median narrow vertical area always more or less bridged, at least above and below. In the Cape de Verde example they are always

[1] Rep. Voy. *Challenger*, Zool., vol. 1, 1880, p. 3.
[2] Scottish Nat. Ant. Exp. Zool., vol. 4, Fishes, 1915, pp. 382-384.
[3] Denk. Ak. Wiss. Wien, vol. 45, 1882, pp. 1-15, pls. 1-6.
[4] Abhand. Naturw. Verein Hamburg, vol. 4, 1859 (1860), p. 27, pl. 4.
[5] Nat. Ausl. Fisch., vol. 9, 1795, p. 85, pl. 417.
[6] Rep. U. S. Fish Comm., 1888 (1892), p. 603.

separate at basal and apical areas, evidently a condition of age. Both have the same fin formula, though the West Indian fish agrees with Jordan and Evermann's Hawaiian [1] in the slightly shorter pectoral, though at present without any traces of the four dark spots on the back below dorsal as shown in the figure. They mention but three blotches as sometimes present. Steindachner notes an example from Acapulco Bay, Mexico, 738 mm. long, but dark dorsal spots are not mentioned.[2]

SELAR CRUMENOPHTHALMUS (Bloch).

Head, 3; depth, $3\frac{1}{4}$ to $3\frac{1}{2}$; D. VIII—I, 25; A. II—I, 22; scales, 50 to 51 — 40 to 41 in lateral line; snout, $3\frac{1}{3}$ to $3\frac{1}{2}$ in head, measured from snout tip; eye, $2\frac{4}{5}$ to 3; maxillary, $2\frac{1}{8}$ to $2\frac{1}{6}$; interorbital, $4\frac{1}{8}$ to $4\frac{1}{3}$; rakers 11 to 13 + 27 or 28, lanceolate, long as filaments, or 2 in eye. Two examples, 223 and 254 mm.

A comparison of scales and other characters, as gill-rakers, radii, scutes, etc., reveals no distinctions other than individual, in examples from the Philippines and Hawaiian Islands. The circuli on the scales are very fine and mostly continuous where approximating.

CEPHALOPHOLIS TAENIOPS (Valenciennes).

Head, $2\frac{3}{5}$; depth, $3\frac{1}{3}$; D. IX, 15, 1; A. III, 9, 1; scales, 107 along and above lateral line to caudal base, and 8 more on latter; 70 pores in lateral line to caudal base and 4 more on latter; 13 scales above lateral line to soft dorsal origin, 26 below to spinous anal origin; snout $3\frac{4}{5}$ in head, measured from upper jaw tip; eye, 6; maxillary, about $2\frac{1}{8}$; interorbital, $5\frac{4}{5}$. Body well compressed, elongate, also caudal peduncle. Head compressed, flattened sides slightly approximate above, and upper profile little concave above nostrils. Snout slightly broader than long. Eye high, well advanced or center near first third in head. Mouth large, lower jaw well protruded. Maxillary to hind pupil edge, expansion $1\frac{7}{8}$ in eye. Teeth in rather wide bands, pair of canines above and double pair below in front. Lower teeth mostly larger, in three or four rows, graduated to inner row which longest, and all but outer row depressible inwards. Patch of large inner depressible teeth each side in front of upper jaw. Sides of upper jaw with outer row of slightly larger erect teeth, and inner row of villiform ones. Vomer and palatines each with row of minute or villiform teeth. Tongue pointed, free. Interorbital broadly convex. Hind preopercle edge minutely and obsoletely denticulate, but very slightly enlarged at angle, which rounded. Rakers IV, 4 + 11 VI, lanceolate, slightly longer than filaments, or $1\frac{2}{5}$ in eye. Scales small,

[1] Bull U. S. Fish Comm., vol. 23, pt. 1, 1903, p. 125, fig. 40.
[2] Sitz, Ak. Wiss. Wien., vol. 72, abth. 1, 1875, p. 64.

crowded, mostly ctenoid, those on head cycloid. Snout scaly, and only very few obsolete maxillary scales. Dorsal origin about opposite pectoral origin, third spine longest or slightly over one-third of head. Soft dorsal inserted little nearer caudal base than hind preopercle edge; fin rounded. Spinous anal inserted about midway between pectoral origin and caudal base, third spine longest or about $3\frac{4}{5}$ in head. Soft anal, like soft dorsal. Caudal rounded. Pectoral broad, rounded, $\frac{3}{4}$ to anal. Ventral origin slightly behind pectoral origin, not quite reaching far back as pectoral tips or to vent, which about an eye-diameter before anal.

Color in alcohol dark brown everywhere except lower or ventral edge with small blue dark-edged spots. On lower side spots more sparse and less crowded than on back and vertical fins. Pectoral also spotted, though ventrals plain brown, but both pairs with dusky edges. Vertical rayed fins narrowly edged bluish. Brown line from near snout tip to eye above, includes nostrils. Another below extends along snout side horizontally till close under eye. Length, 344 mm.

DIAGRAMELLA MACROPS (Pellegrin).

Head, $3\frac{1}{4}$ to $3\frac{1}{3}$; depth, $2\frac{7}{8}$ to 3; D. XIII, 15; A. III, 7: scales 100 to 108 along and above lateral line to caudal base, and 15 to 17 more or less enlarged on latter; tubes, 56 to 58 in lateral line to caudal base and about 10 more on latter; 12 scales above lateral line to soft dorsal origin and 18 or 19 below to spinous anal origin; snout, 3 to $3\frac{1}{8}$ in head; eye, $3\frac{4}{5}$ to 4; maxillary, $2\frac{1}{2}$ to $2\frac{2}{3}$; interorbital, $3\frac{4}{5}$ to 4.

Body elongately ellipsoid, well compressed. Caudal peduncle strongly compressed, least depth $1\frac{1}{4}$ to $1\frac{1}{3}$ its length, or about $2\frac{2}{3}$ in head. Head deep, well compressed; width, 2 to $2\frac{1}{8}$ its length. Snout convex, long as wide or little shorter. Eye large, advanced or hind pupil edge about midway in head length. Mouth moderate, jaws about even. Maxillary beyond front eye edge, not quite to pupil, expansion 2 in eye. Teeth small, in bands in jaws, and outer row enlarged, especially forward. No teeth on roof of mouth or tongue, latter elongate, rounded and free in front. Nostrils large, close together, front one about half an eye-diameter before front eye edge. Interorbital convex. Hind preopercle edge with about 25 to 30 denticles, small and obsolete below. Gill-opening forward about opposite hind maxillary end. Rakers 14+20, lanceolate, about long as filaments or two in eye. Pseudobranchiae slightly shorter than filaments. Scales all finely ctenoid, in oblique series above and below lateral line, smaller about body edges and on head. Snout to nostrils and area around same, maxillary and also most of mandible, naked. Suprascapula densely scaled, hind edge dentate. Cheek with 21 or 22 rows of scales. Pectoral with short concealed axillary scaly flap. Bases of all fins scaly, and caudal largely covered with very minute

scales. Spinous dorsal without scales, and edges of soft dorsal and anal broadly naked. Scales with very fine circuli, mostly waved, and basal radii 5 to 11. Lateral line complete, largely concurrent with dorsal profile, and tubes simple. Spinous dorsal inserted about opposite ventral origin, fifth spine longest or $2\frac{1}{4}$ in head with others graduated down, and edge entire. Soft dorsal origin little nearer spinous dorsal origin than caudal base, rays about equally high or first ray about 3 in head. Anal spines with fine longitudinal striae, second larger and little longer than third or 2 to $2\frac{1}{6}$ in head, fin origin nearly midway between ventral origin and caudal base. Soft anal rounded, first branched ray longest or $1\frac{4}{5}$ to $1\frac{7}{8}$ in head. Caudal deeply emarginate, much less so as fully expanded, fin $1\frac{1}{5}$ to $1\frac{1}{10}$ in head. Pectoral, $1\frac{1}{4}$ in head; ventral, $1\frac{2}{5}$ to $1\frac{1}{2}$ and spine, $1\frac{1}{2}$ to $1\frac{2}{3}$ in fin. Vent about an eye-diameter before anal.

Color in alcohol with general appearance uniform brownish, each scale with pale yellowish median small spot. Fins all pale brownish; edges of dorsals and anal narrowly dusky-brown. Iris brownish. Length, 301 and 302 mm., two examples.

Pellegrin gives the coloration [1] as violet above, also the fins, and lower surfaces orange-yellow. His figure differs from both my examples in showing the second dorsal spine but little less than the third, my examples having it only about half the third. The scales are also not shown on the preorbital, which in my specimens are in about a dozen rows across the narrowest part.

Diagramella Pellegrin [2] is here admitted to generic rank, allied with *Plectorhinchus* Lacépède (= the later *Diagramma* Olsen), in its rather numerous gill-rakers, broad preorbital and rather deep body. It differs in the oblique mouth, rather more dorsal spines (13 compared with 9 to 12) and less elevated head. *Anomalodon* Bowdich [3] is allied with *Parapristipoma* Bleeker in its long anal fin. Bowdich, however, gives a crude figure of his *Pristipoma humilis* [4] and, though the scales are represented as far too large for the present species, still certain details are somewhat suggestive. He says "the forehead of this species has but little elevation," D. XIII, 14; A. II (one very short) and 8 rays; "the fins and tail are a pale yellow, the rest of the fish is silvery." Now the serrate preopercular edge, maxillary, large eye, emarginate caudal and dark marginal lines of the dorsals and soft anal, shown on the figure also invite consideration.

Pristipoma viridense Cuvier [5] is described briefly as uniform brown, second anal spine slightly longer than third, with 12 dorsal and 8 anal rays. Valenciennes next states [6] it has 14 dorsal and 7

[1] Annal. L'Inst. Océanog. Prince de Monaco, vol. 6, fasc. 4, 1914, p. 48.
[2] Bull. Soc. Zool. France, vol. 37, 1912, pp. 292, 295.
[3] Excurs. Madeira, 1825, p. 237.
[4] Idem., p. 236, pl. fig. 40.
[5] Hist. Nat. Pois., vol. 5, 1830, p. 215. San-Iago, ile du cap Vert.
[6] Hist. Nat. Iles Canar., Ichthyol., 1836–44, p. 26.

anal rays, the scales 60, and the large second anal ray striate. The latter gives its color as uniform brown with a blue-black spot on each scale, fins blackish and deeper on soft parts, pectoral paler, ventrals yellowish basally and blackish at tips. Günther gives [1] the dorsal rays 15 and the anal 7, and the lateral line 80, also color uniform brown with dorsal edge more or less distinctly blackish. As these writers place it in *Pristipoma*, the inference is it possesses the central groove below the chin, not found in the above examples.

PAGELLUS MORMYRUS (Linnaeus).

Head, $2\frac{3}{4}$ to $3\frac{1}{10}$; depth, $2\frac{3}{5}$ to $2\frac{5}{6}$; D. XI or XII, 11, 1 or 12, 1; A. III, 10, 1; scales 58 to 60 in lateral line to caudal base and 6 to 8 more on latter; 5 scales above lateral line to soft dorsal origin, 12 below to spinous anal; snout, $2\frac{1}{3}$ to $2\frac{1}{2}$; eye, $4\frac{1}{3}$ to 5; maxillary, $2\frac{3}{5}$ to 3; interorbital, $3\frac{3}{4}$ to $3\frac{7}{8}$. Upper molars in 4 rows and row next to innermost of largest size. Lower molars in 3 rows in front, but median row becomes inner behind, where of larger size. Cheeks with five rows of scales. Trunk with seven narrow brownish cross bars on sides. Three examples, 134 to 219 mm.; one from Loando (p. 284).

Compared with the largest example one from Messina, Italy, of about the same size, shows a longer snout, or eye about $2\frac{3}{4}$ in snout, compared with $2\frac{1}{3}$ or less in the Cape de Verde material. The Messina example with maxillary not reaching much beyond front nostril, while in the Cape de Verde reaching hind nostril. The former with 10+16 rakers and between each dark vertical bar on the back another midway, but fainter and not extending as far below. Scales of all with 9 or 10 basal striae.

LETHRINUS ATLANTICUS Valenciennes.

Head, $2\frac{4}{5}$; depth, $2\frac{3}{8}$; D. X, 9, 1; A. III, 7, 1; P. II, 11; scales 45 in lateral line to caudal base, 5 above to soft dorsal origin, and 14 below to spinous anal origin; 9 predorsal scales; snout, $1\frac{1}{8}$ in head; eye, $4\frac{1}{2}$; maxillary, $2\frac{3}{5}$; interorbital, $4\frac{1}{3}$. Body deep, well compressed, back moderately elevated. Caudal peduncle well compressed, least depth $1\frac{1}{2}$ its length, or $3\frac{1}{8}$ in head. Head pointed, well compressed, width $2\frac{1}{6}$ its length, sides flattened, upper profile slightly concave near snout end and above eye. Eye rounded, elevated, front edge about midway in head length. Mouth large, nearly horizontal, jaws about even. Lips thick, tough, moderately wide. Bands of villiform teeth in jaws, with outer row strongly conic formed as pair of canines in front of each jaw, nine molar behind. No teeth on mouth roof. Maxillary to front nostril, which slightly over half of eye length before and nearly level with lower eye edge. Hind nostril larger above and nearer eye. Interorbital broadly convex. Preopercle

[1] Cat. Fish Brit. Mus., vol. 1, 1859, p. 302. Madeira and St. Vincent.

edge entire. Rakers 5+7 short knobs, $2\frac{3}{5}$ in filaments, and latter $1\frac{5}{6}$ in eye. Pseudobranchiae nearly large as gill-filaments. Scales large, in rows parallel with lateral line. Patch of scales above preopercle, few in postocular region, though opercles scaly, head otherwise naked. Smaller scales on breast and base of caudal than on trunk. Cheek marked by broad area of fine vertical reticulations, all below eye. Suprascapula entire. Scales minutely ciliated and basal striae about 10. Lateral line largely concurrent with back, tubes large and simple. Spinous dorsal inserted about over pectoral origin, fourth spine (damaged) longest, all spines rather robust. Soft dorsal inserted little nearer caudal base than hind preopercle edge, fin rounded, sixth ray $2\frac{3}{5}$ in head. Spinous anal inserted little nearer pectoral origin than caudal base, third or longest spine $3\frac{3}{5}$ in head, and rayed fin like soft dorsal. Caudal little emarginate, upper lobe $1\frac{2}{5}$ in head. Pectoral about $\frac{3}{4}$ to anal, pointed, upper rays longest, $1\frac{3}{5}$ in head. Ventral inserted just behind pectoral base, extends as far back, spine about three-fifths of fin, which $1\frac{3}{4}$ in head. Vent about half an eye-diameter before anal. Color in alcohol largely dull uniform brownish, back darker or more olivaceous. Fins all plain pale brownish. Length, 368 mm.

PSEUDUPENEUS PRAYENSIS (Cuvier).

Head, $3\frac{1}{4}$ to $3\frac{1}{3}$; depth, $3\frac{3}{5}$; D. VIII—I, 8; A. I, 5 or 6; scales, 28 or 29 in lateral line to caudal base, and 3 more on latter; 3 scales above lateral line and 6 below; 7 predorsal scales to occiput; snout, $1\frac{7}{8}$ to $1\frac{9}{10}$ in head; eye, 5 to $5\frac{1}{8}$; maxillary, $2\frac{3}{5}$ to $2\frac{3}{4}$; interorbital, $3\frac{7}{8}$ to 4. Upper teeth biserial. Three outer teeth each side little enlarged and flaring out somewhat backward. No teeth on mouth roof. Cheek with three rows of scales. Scales finely ciliated and with about five basal striae. Two examples, 203 to 209 mm.

The pale spots shown in Bleeker's figure are not now very evident.

BALISTES FORCIPATUS Gmelin.

Head, 3; depth, 2; D. III—III, 26; A. II, 23; P. I, 12; scales, 61 from gill-opening to caudal base and 7 more on latter; 33 scales from rictus to pectoral origin; snout, $1\frac{3}{4}$ in head; eye, 6; interorbital, $3\frac{1}{3}$. Body well compressed, contour ellipsoid. Caudal peduncle and head compressed, profiles slightly concave in front. Preorbital groove about four-fifths of eye. Mouth small, with thick fleshy lips. Median pair of teeth largest and all teeth distinctly notched. Nostrils together, about two-fifths of eye-diameter before eye close over preorbital groove. Interorbital convex. Gill-opening little inclined, equals two-fifths of eye. Scales all roughened, asperities usually in vertical series. Front of first dorsal spine asperous, fins otherwise smooth. Ventral spine rough, followed by 10 narrow thin

spines in flap. Humeral region asperous. First dorsal spine inserted over gill-opening, 1⅝ in head, second about one-third of first, and third still shorter. Soft dorsal origin about midway between hind nostril and caudal base, elevated front lobe with first five branched rays elongate filaments, with first three at least reaching slightly beyond caudal base. Anal like second dorsal, except front lobe without elongated rays. Caudal with upper and lower rays protruded in points, hind edge of fin convex medially. Least depth of caudal peduncle 4⅛ in head, rounded pectoral 2¾.

Color in alcohol brownish generally, paler below. Back with many thickset deep brown round spots, which on flanks and lower surface give place to larger spots of darker color than narrow pale ground-color formed as reticulating lines. Also center of each lower spot with pale spot. Sides of head and trunk with traces of irregular pale bluish dots or small spots. Dorsal and anal spotted darker, especially second dorsal, though paler spots more numerous on anal. Length, 441 mm.

SCORPAENA SENEGALENSIS Steindachner.

Head, 2¼; depth, 3; D. XII, 9; A. III, 5; P. I, 6, XI; V. I, 5; scales from shoulder opposite upper corner of gill-opening, along and above lateral line to caudal base, 45, and 4 more out on latter; tubes, 20 in lateral line to caudal base; 6 scales above lateral line to soft dorsal origin and 13 below to spinous anal origin; 6 predorsal scales; head, width 1⅝ its length measured from upper jaw tip; snout, 3⅜; eye, 6⅜; maxillary, 2¼; interorbital, 5⅜; third dorsal spine, 2¾; fourth dorsal ray, 2⅜; second anal spine, 3; first anal ray, 2⅜; least depth of caudal peduncle, 4⅓; caudal, 1⅗; pectoral, 1½; ventral, 1¾.

Body elongate, back greatly elevated in front with greatest depth at base of second dorsal spine. Caudal peduncle well compressed, and length about two-thirds its least depth.

Head very large, compressed; sides convex and slightly converging above. Snout large, broadly convex over surface and in profile, length about two-thirds its width. Eye moderate, ellipsoid, hind edge advanced little before center in head length. Maxillary oblique, extends opposite hind pupil edge, expansion but slightly less than eye length. Mouth large, wide, and closed mandible but slightly protruding. Bands of villiform teeth in jaws, but not extending across front of either, on palatines and vomer. Lower inner buccal fold narrower than upper. Tongue large, fleshy, wide, free around front edge, surface smooth. Front nostril nearer eye than snout tip, just below frontal spine, with fringed tentacle above nearly high as latter. Hind nostril with similar tentacle, on inner front face of preorbital. Interorbital not quite wide as orbital socket, deeply concave, though bottom more or less leveled. Occiput with deep

cavity nearly wide as interorbital. Deep pit nearly large as pupil below lower eye front.

A pair of frontal spines, conic and sharp pointed. Front of each supraorbital with broad strong spine. Pair of supraorbital spines posteriorly, and lower or second larger. Pair of spines at front of occipital depression, widely separated, and from each hind corner of depression row of four spines extend back, last about opposite base of first dorsal spine. Close below on opercle above two large spines. Pair of small close-set postocular spines close behind each eye. Opercle with two large spines, lower slightly little posterior. Suborbital bony stay with two small spines directed forward, then larger one directed down over most of maxillary width, and finally with four more spines of which first two directed down and others directed backward. Preopercle edge with four spines, uppermost with short prong, and lower broader and more forward.

Gill-opening forward about opposite second nostril. Rakers, III 2+6 IV, robust, rather clavate, short, spinescent, not quite long as filaments, which 1⅓ in eye. Pseudobranchiae about four-fifths of gill-filaments. Isthmus broad, with narrow fleshy elongate-triangular exposed area.

Scales large, in oblique rows on trunk, cycloid, elongate, with very fine incomplete parallel circuli and basal striae about 26 to 34. Smaller scales on caudal base, also on belly, and still smaller on breast and prepectoral region. Head largely covered with rather large though inconspicuous scales. Preocular tentacle about equals vertical diameter of pupil, and supraocular tentacle much larger or about 1⅓ in horizontal eye-diameter. Series of tentacles around snout border, large one in front and another from below and behind, enlarged lower spine at front of suborbital stay, mandible and maxillary with small skinny flaps, and row across cheek below suborbital stay. Others about hind preopercle edge, within interorbital, on preorbital, etc. Skinny flap from hind edge of each scale in lateral line, and many others from scales on sides of trunk, though rather well scattered. Lateral line concurrent with dorsal profile from shoulder to caudal base, not on latter, and tubes all simple and well exposed.

Spinous dorsal inserted little before base of uppermost pectoral ray, spines robust, edge deeply notched but without skinny flaps; third spine longest, last 1⅓ in third, and first shortest. Soft dorsal inserted nearly midway between hind edge of gill-opening and caudal base; fourth ray longest, fin edge notched and reaches back to caudal base. Spinous anal inserted nearly opposite last dorsal spine base, third spine slightly less than second, and first about half of second. Soft anal much higher than soft dorsal, short base slightly less than half height of fin, which rounded and reaches back about opposite

caudal base. Caudal rounded convexly behind. Pectoral large, very broad, extends back but little short of anal, and large thickened lower rays nearly forward to hind preopercle edge. Ventral origin nearly opposite second dorsal spine base. Fin about $\frac{7}{8}$ to anal, and spine nearly $\frac{3}{5}$ of fin. Vent before anal space equal to orbital socket.

Color in alcohol rich brownish generally, variegated with darker to blackish or dusky-brown, or whitish, fading quite pale and with very obscure mottlings on belly and under surface. Head similar, only lower surface more mottled or streaked with whitish. Preorbital region and cheek below with more or less blackish. Fins all brownish, variegated with handsome waved darker bands or streaks. Uppermost portion of each membrane of spinous dorsal dusky, three large dark crossbands on caudal, and about same on pectoral. Ventral and anal paler than dorsal, former more so on inner surface and outer with few obscure or pale brown spots. Iris pale brown, speckled or blotched with darker, and upper half of eye like wrinkled cutaneous curtain.

Length, 295 mm. Cat. No. 42175, U.S.N.M.

The fine example described above agrees quite closely with Steindachner's figures, though they do not show the large blackish blotch below the suborbital stay and another smaller one in the axil just above pectoral base.

The present species is apparently allied with *Scorpaena ustulata* Lowe, of which I have no examples for comparison. However, Bellotti's figure [1] agrees with an Italian example of *Scorpaena scrofa* Linnaeus in the apparently less developed armature of the head, weaker dorsal and anal spines, maxillary extending slightly behind eye edge, and soft dorsal with 10 branched rays. Bellotti also shows an antero-orbital tentacle above and another larger, broader one at same point but still higher, and a dark submarginal blotch between eighth to tenth dorsal spines. In the Italian example noted, which is about the same size as *S. senegalensis*, the latter has a larger and prominent antero-orbital spine, eye $1\frac{1}{2}$ in snout compared with $1\frac{3}{4}$ and the scales very different. In the Italian example the scales are rather less rounded in general contour, and the basal striae much fewer and confined within the limits of the corners of each scale, not spread out like a well-opened fan. Collett figures an example of *S. ustulata* [2] which differs in many ways, a few of which are its lack of tentacles or skinny flaps, very different armature, indication of scales on head only on postocular and below hind part of suborbital stay, hind caudal edge but little convex, greatly longer first anal spine, no preorbital pit, coloration, etc. Compared with *Scorpaena plumieri* Bloch, represented by two examples from Santo

[1] Atti. Soc. Ital. Sci. Nat. Milano, vol. 31, 1888, p. 213, pl. 4, fig. 1.
[2] Res. Camp. Sci. Prince de Monaco, vol. 10, 1896, p. 10, pl. 4, fig. 15.

Domingo, West Indies, and of but little smaller size, the axilla differs in being jet black with a few pure white spots, and rest of inner pectoral surface uniform or at least without dark markings. The basal striae on the scales of *S. plumieri* are also a little coarser, as seen under a lens.

3. Ascension Island.

Situated in the middle of the South Atlantic, this volcanic island was early visited by Osbeck,[1] he listing nine species, several afterwards utilized by Linnaeus. Not until over a century later was further material examined, when Gunther reported on the small lot obtained by the *Challenger*,[2] and then noting three more species the following year.[3]

As a few species obtained by the Eclipse expedition are doubtfully credited to St. Helena Island, it may be useful to note the few faunal works relative to that island. Gunther [4] gives two lists of the collections obtained by Melliss, who also published an interesting general work on the island, including a popular account of its fishes.[5] This is compiled largely from Günther's papers. More recently Cunningham[6] and Clark,[7] the latter in his *Scotia* report, give interesting detailed accounts. Unless otherwise stated, all the material listed under the present caption refers to Ascension Island.

BELONE TRACHURA Valenciennes.

Head, $3\frac{1}{8}$ to $3\frac{1}{6}$; depth, $1\frac{1}{6}$ to $1\frac{1}{3}$ in postocular part of head; D. II, 12; A. II, 17; predorsal scales about 110 to 118; eye, $1\frac{3}{5}$ to $1\frac{2}{3}$ in postocular region; interorbital $1\frac{2}{3}$ to $1\frac{7}{8}$; least width of caudal peduncle, $2\frac{1}{2}$; rakers II, 2 + 6 x or XI; two examples, 339 to 347 mm.

These agree in every way with those from the Azores, except that the lower caudal lobe appears slightly longer than the upper.

ABUDEFDUF ASCENSIONIS, new species.

Head, $3\frac{1}{3}$; depth, $1\frac{3}{4}$; D. XIII, 13; A. II, 13; P. I, 17; V. I, 5; scales, about 26 in lateral series from shoulder to caudal base medially, and 8 more larger ones on latter; tubes, 20 in lateral line; 5 scales above lateral line to soft dorsal origin and 11 below to spinous anal origin; head, width $1\frac{7}{8}$ its length; snout, $3\frac{3}{5}$; eye, 4; maxillary, $3\frac{7}{8}$; interorbital, $3\frac{1}{3}$; fifth dorsal spine, 2; fourth dorsal ray, $1\frac{1}{4}$; second anal spine, 2; fourth anal ray, $1\frac{1}{4}$; least depth of caudal peduncle, $1\frac{4}{5}$; caudal, $1 + \frac{1}{6}$; pectoral, $1 + \frac{1}{5}$; ventral, $1\frac{1}{10}$.

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[1] Reise Ost.-Ind. China, 1765, pp. 385–396.
[2] Rep. Voy. *Challenger*, Zool., vol. 1, 1880, p. 5.
[3] Ann. Mag. Nat. London, ser. 5, vol. 8, 1881, pp. 430–440.
[4] Proc. Zool. Soc. London, 1868, pp. 225–228; 1869, pp. 238–239.
[5] St. Helena (London), 1875, Fishes, pp. 100–113, pls. 19–21.
[6] Proc. Zool. Soc. London, 1910, pp. 86–130, pls. 1–3.
[7] Scottish Nat. Ant. Exp. Zool., vol. 4, Fishes, 1915, pp. 387–393.

Body deeply ovoid, well compressed, back much elevated, though predorsal scarcely trenchant. Caudal well compressed; depth, two-thirds its length.

Head large, deep, greatly compressed, flattened sides but slightly converging below. Snout convex, length two-thirds its width. Eye rounded, but slightly elevated, advanced, with hind edge about midway in head length. Mouth small, with short gape, and lower jaw but very slightly protruding. Lips moderately wide. Maxillary to nostrils and expansion about half of eye. Teeth uniserial, incisor like, and end of each with slight notch. Tongue pointed and free in front. Nostril simple pore, nearly opposite eye center or

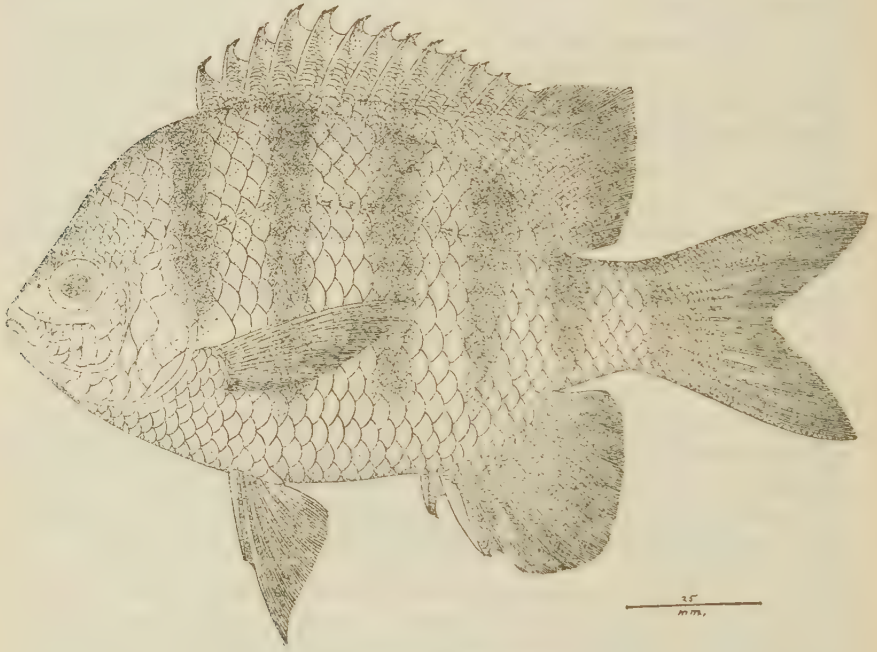

FIG. 4.—ABUDEFDUF ASCENSIONIS.

about last third in snout. Interorbital convex. Infraorbital width little less than vertical pupil diameter, edge entire; also hind preopercle edge.

Gill-opening forward about opposite nostril. Rakers about 7 + 18, lanceolate, but slightly shorter than filaments, which 1¼ in eye. Pseudobranchiae nearly long as gill-filaments. Isthmus narrow, rather slender.

Scales large, finely ciliated, smaller along body edges, and become quite crowded and minute on fin bases. Humeral scale enlarged and suprascapula entire. Pointed scaly axillary ventral flap about 3 in fin. Cheek with four rows of scales. Each scale with about

8 to 10 basal striae. Lateral line concurrent with dorsal profile only extends until about midway in soft dorsal base. Tubes simple, well exposed.

Spinous dorsal origin slightly behind pectoral origin; after fifth spine subequal edge notched. Soft dorsal origin about last third between suprascapula origin and caudal base, fourth ray longest with others graduated down, extends back slightly beyond caudal base. Spinous anal origin about midway between pectoral origin and caudal base, first spine slightly less than half length of second. Soft anal lower than soft dorsal; fourth ray longest; fin about reaching caudal base. Caudal deeply forked, pointed lobes similar. Pectoral long, not quite to anal origin, upper rays longest. Ventral inserted behind pectoral base, fin nearly to anal origin, and spine about half its length. Vent close before anal.

Color in alcohol largely dull brownish olive, paler below. Back and sides with 5 dark-brown broad vertical cross-bands, darker above lateral line. Fins all brownish, dorsal without distinct reflections of dark vertical bars on back, and outer portions of soft dorsal, anal, and ventral dusky or dark brown. Axial of pectoral dark brown. Iris brownish. Length 165 mm.

Type.—Cat. No. 42315, U.S.N.M. Ascension Island. Wm. Harvey Brown. U. S. Eclipse Expedition to W. Africa, 1889.

Also another example, paratype, same data; paratypes 42,314 two examples, same data; 42,316, four examples, Ascension Island or Saint Helena. These show: head 3 to $3\frac{1}{5}$; depth $1\frac{3}{4}$ to $1\frac{5}{6}$; D. XIII, 13; A. II, 13; tubes in lateral line 20 or 21, with 9 or 10 scales counted on to caudal base; 4 or 5 scales above lateral line to soft dorsal origin and 11 or 12 below to spinous anal origin; snout $3\frac{2}{5}$ to $3\frac{4}{5}$ in head; eye $3\frac{1}{3}$ to 4; maxillary 3 to $3\frac{3}{5}$; interorbital $2\frac{7}{8}$ to $3\frac{1}{2}$; rakers 6 or 7 + 18 or 19; length 69 to 135 mm.

Compared with a series of examples of *Abudefduf marginatus* (Bloch) from the Bahamas, St. Martins, West Indies, Florida, and Panama, the present species differs in the outer portion of soft dorsal dusky, dark transverse band on caudal peduncle reflected as dusky band across soft dorsal basally and the presence of 13 anal rays. The West Indian species has a shorter or slightly more rounded or orbicular contour and 12 anal rays.

(For the Ascension Islands.)

THALASSOMA ASCENSIONIS (Quoy and Gaimard).

Head 3 to $3\frac{2}{5}$; depth $3\frac{1}{3}$ to $3\frac{1}{2}$; D. VIII, 14; A. III, 12; P. I, 14; V. I, 5; scales 27 in lateral line to caudal base and 1 more on latter; 3 scales above lateral line to soft dorsal origin, 9 below to spinous anal origin; 8 predorsal scales; snout $2\frac{1}{2}$ to $3\frac{2}{5}$ in head; eye $4\frac{2}{5}$ to $6\frac{1}{3}$; maxillary $3\frac{3}{5}$ to $6\frac{1}{3}$; interorbital $4\frac{1}{4}$ to $4\frac{1}{2}$.

Body strongly compressed, elongate. Caudal peduncle deep, compressed, length about three-fifths its width. Head greatly compressed, width $2\frac{2}{3}$ its length. Eye small, round, elevated; hind edge slightly advanced in head length. Maxillary about two-thirds to eye, not quite to front nostril. Lips rather fleshy. Teeth conic, even in front of jaws, slightly curved, uniserial, pair of canines in front of each jaw. Nostrils small pores, hind one level with upper eye edge and close to its front edge. Interorbital convex. Rakers about 6+9 short points, one-fourth of filaments; latter nearly long as eye. Pseudobranchiae about three-fourths of filaments. Head naked. Scales reticulate medially, basal striae 23 to 47 and apical striae 11 to 24. Scales on breast smaller than sides, still more so on predorsal and caudal base. Lateral line complete, high on back at first, drops midway on caudal peduncle and tubes simple to four-branched. Spinous dorsal inserted slightly before pectoral origin, slightly behind in young, last spine longest or $3\frac{2}{3}$ to $4\frac{1}{3}$ in head. Soft dorsal inserted about opposite depressed pectoral tip, fifth ray $2\frac{1}{3}$ to $2\frac{1}{2}$ in head. Anal inserted little behind soft dorsal origin, third or largest spine, $4\frac{1}{2}$ to $4\frac{3}{4}$ in head; first anal ray, $2\frac{2}{3}$ to 3. Least depth of caudal peduncle $1\frac{7}{8}$ to $2\frac{1}{5}$. Caudal emarginate behind, corners pointed, $1\frac{1}{8}$ to $1\frac{1}{3}$ in head. Caudal rounded convexly behind in young. Pectoral $1\frac{1}{2}$ to $1\frac{1}{3}$ in head; ventral $1\frac{1}{3}$ to $3\frac{1}{2}$ and inserted little behind pectoral. Ventral nearer anal.

Color in alcohol generally brown; lower surface paler. Each scale with dark median and basal vertical line so whole trunk appears evenly and finely cross-barred. Membranes between first three dorsal spines black. Also small black spot at pectoral origin. Dorsals and anals each with lengthwise brown band medially entire length of fins, otherwise pale brownish. Caudal pale yellowish, edges above and below, also base, deep brown. Pectoral and ventral darker at ends, general color brown. Iris pale brown. Young without dark vertical lines very distinct, though broad longitudinal dark band, from snout tip to caudal base medially, conspicuous. Length, 79 to 153 mm., three examples. Ascension Island or St. Helena.

The smallest of the above is doubtless identical with *Julis ascensionis* Quoy and Gaimard,[1] based on an example 90 mm. long. Their figure shows the red band through the eye much narrower than over the costal region, and a dark line transversely at pectoral base, whereas in my example the small spot at the fin origin is characteristic as in the larger examples. Quoy and Gaimard also figure a scale showing but 11 basal and as many apical striae, which is a lower number than I find for basal striae. The adult is next described as *Julis sanctae-helenae* Valenciennes.[2] Though Günther only

[1] Voy. *Astrolabe*, vol. 3, 1835 (March 17), p. 706, pl. 20, fig. 5. L'île de Ascension.
[2] Hist. Nat. Poiss., vol. 13, 1839, p. 280. Sainte Hélène.

notes[1] each scale has a darker center, Valenciennes carefully mentions in detail the fine dark vertical lines. Melliss has a very crude colored figure[2] which does not show the dark spot at the front of the spinous dorsal or the pectoral origin. Finally, Günther gives a note on the change of color with age, in Ascension examples.[3]

CHAETODON SANCTAE-HELENAE Günther.

Head, 4; depth, $1\frac{3}{5}$; D. XIII, 21; A. III, 19; P. II, 13; V. I, 5; scales, 52 from shoulder to caudal base medially and about 8 more on latter; tubes, 36 in lateral line; 10 or 11 scales above lateral line

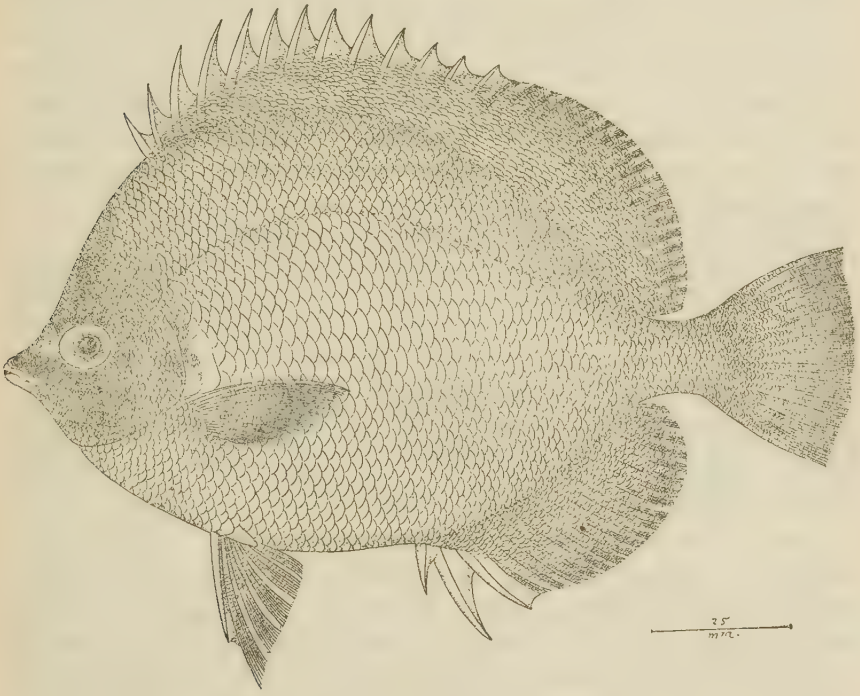

FIG. 5.—CHAETODON SANCTAE-HELENAE GÜNTHER.

to spinous dorsal origin, 23 or 24 below to spinous anal origin; head width, 2 in its length; snout, $3\frac{2}{5}$; eye, $3\frac{2}{5}$; maxillary $3\frac{4}{5}$; interorbital, 3.

Body orbicular, strongly compressed. Caudal peduncle well compressed; length about three-fourths its least depth. Head deep, upper profile more concave than lower. Snout conic, about long as wide. Eye rounded, advanced, hind pupil edge about midway in head length. Mouth small; lower jaw slightly protruding. Lips rather thin. Teeth in brush-like bands, though lower much firmer or as if welded into firm cutting edge. Maxillary small, largely concealed

[1] Cat. Fish. Brit. Mus., vol. 4, 1862, p. 191.
[2] St. Helena, 1875, p. 109, pl. 21, fig. 2.
[3] Rep. Voy. *Challenger*, Zool., vol. 1, 1880, p. 5.

by preorbital, expansion about 3½ in eye, nearly to hind nostril. Nostrils together, close before eye. Interorbital convex. Preopercle edge entire, with slight emargination at corner. Rakers, 4 + 16 short points, about one-fourth of filaments; latter 2½ in eye. Scales largest on middle of side, become very small on head and vertical fins, finely ciliated, largest with about 12 basal striae. Courses of scales slightly oblique upward behind, rows converging smaller toward caudal peduncle and forward toward head. Pointed ventral axillary scaly flap nearly two-fifths of fin. Lateral line largely concurrent with profile of depressed dorsals; tubes largely simple. Spinous dorsal begins little before pectoral origin, fifth spine longest or two-thirds of head, fin edge deeply notched. Soft dorsal inserted little nearer caudal base than head. Spinous anal inserted trifle before soft dorsal origin, nearly midway between hind eye edge and caudal base, second spine longest, or about 1⅓ in head. Soft anal like soft dorsal. Caudal but very slightly less than head, truncate, convex behind when expanded. Pectoral about long as caudal, and ventral but very slightly shorter; spine 1⅓ in head. Vent close before anal.

Color in alcohol largely dull uniform brown, back slightly darker. Each scale with small pale basal spot. Obscure broad dull brown band from predorsal just before spinous dorsal, wide as pupil, down over cheek but not below latter. No trace of other markings. Edges of soft vertical fins narrowly dusky. Ventral tinged brownish on outer portions. Soft dorsal, anal, and caudal all pale yellowish-brown, with pale shade across front of caudal peduncle. Iris pale brown. Length, 138 to 147 mm., two examples.

POMACANTHUS PARU (Bloch).

Head, 3½; depth, 1⅔; D. X, 29; A. III, 23; pores in lateral line, 50 (?) to caudal base; snout, 2½ in head from upper jaw tip; eye, 3⅔; maxillary, 3⅛; preopercle spine, 4⅛; interorbital, 2⅔; least depth of caudal peduncle, 1⅛ in entire head length; caudal, 1⅔ pectoral, 1⅛; ventral spine, 2$\frac{1}{10}$; rakers, 4 + 12. General color blackish, with numerous large scales of back and sides edged narrowly as whitish crescent. These crescents gradually shorter and more dotlike as they progress out on vertical fins. Scales of head, breast, predorsal, and abdomen uniformly dark. Whitish band from front nostril to eye, and extends along lower edge as very narrow whitish border. Lower lip pale, chin and mandible whitish. Ventral blackish. Length, 240 mm.

This species is apparently not known from Ascension Island previously, and unfortunately no material is at hand for comparison. Two examples of the allied *Pomacanthus arcuatus* (Linnaeus) from Key West, Florida, 203 and 210 mm. long, differ in the distinctions claimed

by Jordan and Evermann.[1] The Key West examples do not show any pale bar from the nostril to the eye, or pale narrow border below the eye, their soft dorsals and anals are narrowly edged with whitish behind, caudal broadly white, pectoral uniform blackish basally and in surrounding region, all scales broadly edged whitish or gray on trunk and dorsal and anal bases; also many white spots extend forward even until well before pectoral; nostril much further advanced before eye and lower or about level with lower eye edge, and lips prominently dusky. A point in agreement is the pale chin. A larger dried example of *P. arcuatus* from Nassau, Bahamas, 408 mm. long, now appears uniformly brownish-black, but in its large scales and lowered nostrils, which about three-quarters an eye-diameter before eye agrees with the Key West examples. No difference is apparent in the general scale structure, the apical spinules of about similar extent, and the basal striae vary 7 or 8 in both species.

BALISTES VETULA Linnaeus.

Head, 3; depth, $1\frac{5}{6}$; D. III—III, 28; A. II, 25; P. I, 13; scales 58 from gill-opening to caudal base and 5 more on latter; 30 scales from rictus to pectoral origin; snout, $1\frac{1}{3}$ in head; eye, $5\frac{1}{2}$; interorbital, 4; first dorsal spine, $1\frac{4}{5}$; second branched dorsal ray, $1\frac{1}{8}$; least depth of caudal peduncle, $4\frac{1}{4}$; pectoral, $2\frac{3}{5}$.

Body well compressed, contour ellipsoid. Caudal peduncle and head compressed, lower profile of latter slightly more convex than upper. Preorbital groove about long as eye. Mouth small, terminal, with thick fleshy lips. All teeth slightly notched, median pair in each jaw largest. Nostrils together, about two-fifths of eye diameter before eye close over preorbital groove. Interorbital convex. Gill-opening little inclined, long as space between front nostril and hind eye edge. Scales all asperous, mostly with regular <-shaped row of close-set asperities along front of each. Front of first dorsal spine asperous; fins otherwise smooth. Ventral spine finely roughened, and about 18 narrow thin spines in flap. Humeral region spinescent, like surrounding scales. First dorsal spine inserted over large humeral scales close behind gill-opening. Second dorsal spine slightly less than half of first and third, little shorter than second. Second dorsal origin about midway between hind nostril and caudal base, pointed front lobe reaching caudal base. Anal like second dorsal but with shorter point in front. Caudal deep, upper and lower points produced, concave; hind edge slightly convex when expanded. Pectoral rounded.

Color in alcohol brownish generally, little paler on head below. Pale bluish streak from near snout tip until close below pectoral base.

[1] Bull. U. S. Nat. Mus., No. 47, vol. 2, 1898, p. 1680.

Another from snout tip, around lips, then from along upper lip, parallel with upper streak, and ends shortly before its bend. Just below nostril dark line toward eye below, and then continued as pale blue line to pectoral origin. Another dark line above nostril to eye and two others behind transversely over interorbital. Also dark line from hind eye edge toward dorsal spine, but not reaching base of latter. In front of it on short predorsal two other short dark bars. From lower hind eye edge two pale blue lines to humeral scales and little behind eye short oblique blue line toward second dorsal spine, and another toward anal. Dorsal, anal, and caudal each with moderate pale blue submarginal band; fins otherwise brown. Pectoral brown, outer portions paler. Also pale blue band at caudal base and broader one across caudal peduncle. Iris pale brown, narrow brown circle around pupil. Length, 266 mm. to caudal base; 378 mm. to end of caudal filaments.

The example already noted from the Azores agrees in every way, except as due to age, in the much longer caudal filaments and the presence of two dorsal filaments from front of soft dorsal.

Compared with a dried example 385 mm. long to caudal base from St. Christopher's Island, West Indies, the latter varies in 26 branched dorsal rays and about 61 scales from gill-opening to caudal base. The two large blue bands over the cheek are like those in my Ascension and Azores examples, the upper not touching the pectoral base or showing a broad triangular area below the same. The St. Christopher's fish has the upper band double the width of the lower and approaching nearer the pectoral origin or upper pectoral base than indicated in Nichols and Murphy's figure of their *Balistes vetula trinitatis*.[1] All of my examples have a deeper or less slender muzzle, and the lower profile a little more convex than upper. A small example from St. Croix, West Indies, 180 mm. to caudal base, shows the upper band but little broader than the lower and approaching near lower part of caudal base. Its soft dorsal with 27 branched rays and scales 60.

MELICHTHYS PICENS (Poey).

Head, $3\frac{2}{3}$; depth, 2; D. III —II, 31; A. II, 28; P. I, 15; scales, 60 from gill-opening to caudal base and 6 more on latter; 21 scales from rictus to pectoral origin; snout, $1\frac{1}{3}$ in head; eye, 5; interorbital, $2\frac{3}{4}$; first dorsal spine, $1\frac{2}{3}$; second branched dorsal ray, $1\frac{1}{2}$; least depth of caudal peduncle, $2\frac{2}{3}$; pectoral, $2\frac{1}{4}$.

Body well compressed, upper profile more evenly convex than lower, which bulging more in front. Caudal peduncle and head compressed, profiles alike. Preorbital groove about long as eye. Mouth

[1] Bull. Amer. Mus. Nat. Hist. N. Y., vol. 33, 1914, p. 265, fig. 3. South Trinidad Island. See also Copeia, Jan. 24, 1917, No. 39, p. 1. Ascension Island. Also April 15, 1918, No. 56, p. 47.

small; lips moderately fleshy. Median teeth largest, edges of all entire or truncate. Nostrils together, about half an eye-diameter before eye, well above preorbital groove. Interorbital convex. Gill-opening little inclined, 1⅓ in eye. Scales roughly striate, and striae mostly horizontal. Front of first dorsal spine finely roughened, also most of pectoral and caudal bases and caudal rays. Ventral spine coarsely rough, not followed by spines but simply rough edges of scales. Humeral region finely asperous. First dorsal spine inserted over gill-opening, second spine about two-fifths of first and short third one concealed in groove of fin. Second dorsal origin about midway between front nostril and hind tip of last dorsal ray, and front branched rays highest, but not forming lobe. Anal like second dorsal. Caudal concave behind, fin 1¼ in head. Pectoral rounded.

Color in alcohol uniform deep blackish-brown, with chocolate tint. Bases of dorsal and anal each with narrow white line. Caudal with transverse submarginal line behind its outer edge bordered with narrow pale or whitish line. On head above many blue-black lines extend from one eye to other and in front along preorbital groove well down on snout. Others also unite and extend forward from nostrils. Teeth and iris pale. Length, 318 mm.

The synonomy of this species has been greatly complicated. It is evidently the species intended as *Balistes niger* Osbeck, as cited by Linnaeus under his *Balistes ringens*.[1] Osbeck's name is next published in similar fashion by Forster,[2] so Bloch is then the first to propose *B. niger* in available form,[3] but is antedated for a different fish by the *B. niger* of Mungo Park.[4] *B. ringens* Linnaeus is said by Bleeker[5] to be a species near *Balistes chrysospilus* Bleeker. Bloch's figure is quite crude and does not show the striking narrow whitish lines along the dorsal and anal bases, as so well represented in Lacépède's figure and subsequent ones.

ALUTERA SCRIPTA (Osbeck).

Head, 3 to 3⅛; depth, 2⅜ to 2¾; D. 46 or 47; A. 47 to 49; eye, 5⅔ to 5⅘ in head; interorbital, 4⅛ to 4⅔. Three examples, 330 to 418 mm. Variably spotted with dusky or brownish-black and most spots concentrate around eye. Many leaden spots, streaks, or blotches distributed between dark spots.

[1] Syst. Nat., ed. 10, 1758, p. 329. Ad ins. Ascensionis.
[2] Voy. China Osbeck, vol. 2, 1771, p. 93. Ascension Island.
[3] Nat. Ausl. Fisch., vol. 2, 1786, p. 27, pl. 152. Chineschen Gewassern.
[4] Trans. Linn. Soc. London, vol. 3, 1797, p. 37. Sumatra.
[5] Atlas Ich., vol. 5, 1865, p. 108.

LEPTECHENEIS NAUCRATES (Linnaeus).

Head, $5\frac{1}{4}$; depth, $8\frac{1}{2}$; laminae, 23; D. IV, 35; A. III, 36; snout, $2\frac{1}{10}$ in head from upper jaw tip; eye, $6\frac{3}{4}$; maxillary, 3; interorbital, $1\frac{3}{5}$; pectoral, $1\frac{1}{4}$ in entire head length; ventral, $1\frac{2}{3}$; disk, $4\frac{1}{4}$ in body; rakers, 1+11. Dark brown band through eye equals eye width, then expands to basal pectoral width, to become lighter along side to caudal base. Length, 610 mm.

Local New Jersey examples usually show 21 or 22 laminae and rakers 3+10 to 14.

BLENNIUS ATLANTICUS (Valenciennes).

Head, $4\frac{1}{5}$; depth, $4\frac{4}{5}$; D. XI, 23; A. I, 23; head width, about 2 in its length; snout, $2\frac{1}{5}$; eye, $3\frac{2}{3}$; maxillary, $2\frac{2}{5}$; interorbital, 2 in eye. Body well compressed, deepest about middle of pectoral. Caudal peduncle well compressed, least depth 3 in head. Head short, deep, steep front profile but little inclined from vertical. Eye high, within bulge and close to upper profile. Mouth inferior, broad, lower jaw shorter. Maxillary to eye center. Lips wide. Row of fine pectinate teeth in each jaw, very numerous and uniform. Lower jaw only with long slender canine each side. Interorbital shallowly convex. Rakers 30 and simple on outer side of first arch, 20 and many bifid or trifid on inner side of first arch, longest barely $\frac{1}{4}$ of filaments, which about half of eye. Supraorbital tentacle long as vertical eye-diameter and front nasal tentacle little less. Small short tentacle each side of occiput. Dorsal slightly notched at soft dorsal origin, third spine about $1\frac{1}{3}$ in head, third ray $1\frac{2}{3}$ and last ray joined to front of caudal above. Anal begins much nearer snout tip than caudal base, fourth ray $1\frac{3}{4}$ in head and last ray free. Caudal with lower rays longest, rounded behind, fin $1+\frac{1}{8}$ in head, pectoral $1\frac{1}{10}$, ventral $1\frac{1}{3}$. Color in alcohol brown, dusky to blackish, largely uniform, and belly slightly duller brown. Iris whitish. Fins all blackish, except upper caudal edge broadly whitish and edge of soft dorsal pale brown. Length, 100 mm. Ascension Island or St. Helena.

Apparently agrees with an example, 68 mm. long, from Colon, Panama, though it has D. XI, 20 and A. I, 21. *Alticus macclurei* Silvester [1] from Porto Rico is the half-grown stage, not showing any structural characters worthy of separation.

ALTICUS TEXTILIS (Valenciennes).

Head, $3\frac{5}{6}$ to 4; depth $4\frac{2}{5}$ to $5\frac{1}{4}$; D. XI or XII, 14 or 15; A. I, 15 or 16; head width, $1\frac{1}{2}$ to $1\frac{3}{5}$ in its length; snout, 3 to $3\frac{1}{2}$; eye, $4\frac{1}{4}$ to 5; maxillary, 2 to $2\frac{1}{6}$; interorbital, $1\frac{1}{2}$ in eye. Body well compressed, deepest

[1] Papers Marine Biol. Carnegie Inst., Wash., vol. 12, 1918, p. 24, pl. 3, fig. 2.

about midway in pectoral. Least depth of caudal peduncle, $2\frac{7}{8}$ to $3\frac{1}{8}$ in head. Head oblong, front profile rather convex, well inclined. Eye high, within bulge and close to upper profile. Mouth inferior, broad, lower jaw shorter. Maxillary to hind eye edge. Lips wide. Row of fine pectinate teeth in each jaw, very numerous and uniform. Lower jaw only with long slender canine each side. Interorbital shallowly convex. Rakers about 14 weak points one-third of filaments and latter $1\frac{1}{2}$ in eye. Supraorbital tentacle about two-thirds of eye and front nasal tentacle about half as long. Dorsals nearly separated, first spine, $2\frac{1}{4}$ in head; third dorsal ray, $1\frac{7}{8}$; third anal ray, $2\frac{1}{4}$; caudal, $1\frac{1}{8}$; pectoral, 1; ventral, $1\frac{2}{3}$. Color brownish generally with about 14 rather obscure vertical brownish bands which have row of several whitish dots, usually about three with median about midway in body depth. Several browish spots on side of head. Two large black blotches, first smaller and embraces pectoral origin, edges of both whitish. Dark bars on trunk reflected

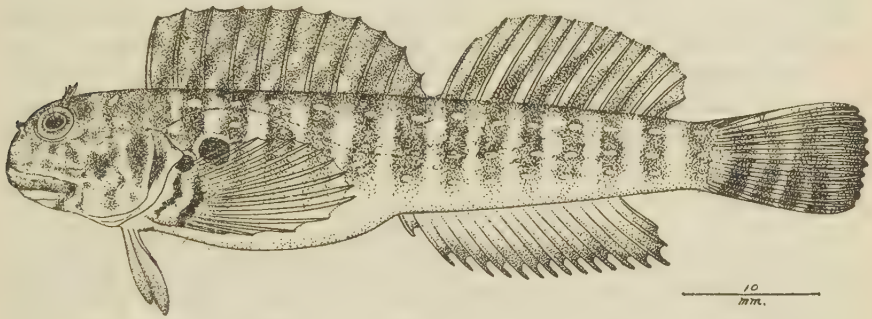

FIG. 6.—ALTICUS TEXTILIS (VALENCIENNES).

on dorsals obliquely up backward. Caudal with four dark transverse bands. Anal brownish, edge dusky. Pectoral pale brown, with broad deep brown basal band and another parallel on prepectoral. Iris whitish. Two examples, 63 to 65 mm.

4. FREETOWN, SIERRA LEONE.

No faunal papers have appeared and the species described from the colony are mostly scattered through the works of Günther and Boulenger. The fresh-water fauna is little known. The marine fauna may be understood in conjunction with the extensive papers by Pellegrin and [1] Steindachner [2] relative to the Senegal region, and Klaptocz [3] relative to French Guinea. Pellegrin also described

[1] Bull. Soc. Zool., France, 1905, pp. 135–141; 1907, pp. 83–89; 1911, pp. 182–186; 1913, pp. 116–118.—Actes Soc. Linn, Bordeaux, 1903, pp. 15–57, pl. 3; 1907, pp. 71–103. — Annals L'Inst. Océanogr., Prince de Monaco, vol. 6, fasc. 4, 1914, pp. 1–100, pls. 1–2.

[2] Sitz. Ak. Wiss. Wien, vol. 60 (1), 1869, pp. 669–715, 945–996; vol. 61 (1), 1870, pp. 533–583.

[3] Zool. Jahrbuch. Syst., 1913, pp. 279–290.

new species from the last-named region.[1] Papers relative to Liberia are mentioned further on.

ALBULA VULPES (Linnaeus).

Head, $3\frac{3}{5}$ to $3\frac{2}{3}$; depth, $4\frac{2}{5}$ to 5; D. III, 14, 1; A. III, 6, 1; scales 68 to 71 in lateral line to caudal base and 6 more on latter; 9 scales above lateral line, 6 below; 27 or 28 predorsal; snout, $2\frac{2}{3}$ to $2\frac{1}{2}$ in head; eye, $4\frac{3}{5}$ to $4\frac{4}{5}$; maxillary, $2\frac{4}{5}$ to $3\frac{1}{10}$; interorbital, $2\frac{4}{7}$ to 3; rakers, 9 or 10+10. Two examples, 324 to 329 mm. Compared with Atlantic specimens from Panama the scales are indistinguishable.

ETHMALOSA DORSALIS (Valenciennes).

Two examples.

GALEICHTHYS LATISCUTATUS (Günther).

Two examples, 241 and 281 mm. The larger example differs in the adipose fin about half size of smaller example. Rakers, 4 + 9. Maxillary barbel extends but very little beyond pectoral origin, outer mental barbel three-fourths of space to same. Depressed dorsal $1\frac{3}{4}$ to adipose fin. Upper caudal lobe longer.

The smaller example has the adipose fin $2\frac{1}{2}$ in head. Rakers, 5 + 8. Depressed dorsal 3 to adipose fin. In both the patches of vomerine-pterygoid teeth resemble those figured by Günther[2] under *Arius parkii* rather than as indicated by Boulenger.[3]

SERIOLA FASCIATA (Bloch).

Head, $2\frac{7}{8}$ to 3; depth, $2\frac{3}{5}$ to 3; D. VII or VIII I, 29 to 32; A. II I, 18 to 21; snout, 3 to $3\frac{2}{5}$ in head; eye, $3\frac{7}{8}$ to $4\frac{1}{8}$; maxillary, $2\frac{1}{3}$ to $2\frac{1}{3}$; interorbital, 3 to $3\frac{2}{5}$.

Body fusiform, well compressed, deepest at soft dorsal origin. Head width, 2 to $2\frac{1}{8}$ in its length. Snout convex, about long as wide. Eye rather large, advanced, hind edge about midway in head length. Mouth large, jaws about even. Maxillary to pupil, expansion $1\frac{2}{3}$ to 2 in eye. Teeth in villiform bands in jaws, on vomer and palatines. Nostrils together, midway in snout. Interorbital convex, with median keel to spinous dorsal. Rakers about 6+15, lanceolate, long as filaments and latter $1\frac{3}{4}$ in eye. Scales minute, cycloid, with 4 to 8 basal striae and circuli rather coarse. Cheek with row of 12 to 14 scales. Lateral line well arched, curve $1\frac{1}{3}$ to $1\frac{2}{5}$ in straight portion. Spinous dorsal inserted little behind pectoral origin; fourth spine, 4 to $4\frac{1}{5}$ in head. Soft dorsal inserted midway between snout tip and caudal base; first branched ray, $1\frac{7}{8}$ to 2 in head. Anal like soft dorsal, only shorter; neither fin lobate in front and first branched ray $2\frac{3}{5}$ to 3 in head. Caudal well forked, $1\frac{1}{3}$ in head; pectoral, $1\frac{4}{5}$ to $1\frac{7}{8}$; ventral, $1\frac{1}{3}$ to $1\frac{2}{5}$.

[1] Bull. Soc. Zool., France, 1913, pp. 236–241.
[2] Cat. Fish. Brit. Mus., vol. 5, 1864, p. 155.
[3] Cat. Fresh-Water Fish. Africa, vol. 2, 1911, p. 385, fig. 297.

Color in alcohol brown above, paler below. Back with six pairs of close-set obscure deeper brown cross bars. Broad brown band from upper hind eye edge to spinous dorsal. Dorsals dusky or blackish-brown, paler basally on soft fin and edge broadly contrasted in young. Apex of soft dorsal pale or whitish. Anal pale brown with broad marginal dark band. Ventral blackish; rays and lower surfaces whitish. Pectoral and caudal brownish. Thirteen examples, 98 to 120 mm. All obtained at sea, in latitude 6° 38′ N.; longitude 13° 40′ W.

Bloch's figure of his *Scomber fasciatus*,[1] though very crude in its transverse bands, shows unmistakable characters in the short round pectoral, dark band from upper hind eye edge toward occiput, etc.

CARANX AFRICANUS Steindachner.

Head, 3⅔ to 3¾; depth, 2½ to 2¾; D. VII–II, 20 or 21; A. II–II, 17 or 18; scutes in lateral line, 42 to 45; snout, 3⅔ to 3⅘ in head from upper jaw tip; eye, 3⅘ to 3¾; maxillary, 2½ to 2⅘; interorbital, 3¼ to 3⅗; rakers, 12 + 28 to 30; two examples, 323 and 334 mm. In the larger example the long dorsal lobe is 1⅘ in fin base.

PSEUDOTOLITHUS BRACHYGNATHUS Bleeker.

Head, 3½; depth, 3⅔ to 3⅘; D, X, I, 26 or 27; A. II, 7, I; tubes, 50 or 51 in lateral line to caudal base; 6 scales above lateral line to soft dorsal origin and 7 below to spinous anal origin; 17 predorsal scales to head; snout, 4¼ to 4⅓ in head from upper jaw tip; eye, 5 to 5¾; maxillary, 2¼; interorbital, 6 to 6⅛. Elongate, well compressed, back moderately elevated, deepest at spinous dorsal base medially. Caudal peduncle strongly compressed; least depth, 1 to 1⅛ its length, or 3¼ to 3⅔ in total head length. Head width, 2⅔ to 2½ its length. Snout, convex; length two-thirds to three-fourths its width. Eye little ellipsoid; hind edge advanced about half an eye-diameter beyond center in head length. Mouth large, lower jaw protruding. Teeth biserial, upper with outer row of well-spaced canines and inner row of small uniform close-set conic teeth; lower teeth reversed. Front above with two moderate inclined canines set little inside. Maxillary to hind pupil edge, expansion largely concealed, about seven-eighths of eye. Interorbital convex. Few uneven denticles along hind preopercle edge largely concealed. Rakers, II, 3 or 4 + 9, V, lanceolate, equal filaments or 1⅘ in eye. Scales large, narrowly imbricated, finely ciliated, in oblique rows above and below lateral line, which become horizontal below lateral line after anal and above after soft dorsal. Scales with 20 or 21 basal radii, circuli often complete and as very fine vermiculations medially. Suprascapula entire. Row of small scales on soft dorsal base, and caudal

[1] Nat. Ausl. Fisch., vol. 7, 1793, p. 73, pl. 341. Vaterland unbekannt.

base and breast scales also small. Tubes of lateral line large, with many as 8 or 10 branches. Third dorsal spine, 1¾ to 2 in head, third ray, 2⅛ to 3⅖. Anal small, inserted much nearer caudal base than ventral origin; second spine, 3⅞ to 4 in head. Caudal ends in long median point behind, 1⅕ to 1¼ in head; pectoral, 1⅔ to 1⅗; ventral, 1⅔ to 1½. Vent nearly an eye-diameter before anal.

Color in alcohol brownish above, sides and below silvery-white. Iris and most of head silvery-white. Dark band extends medially along each row of scales on trunk above. Spinous dorsal with outer portions dusky. Soft dorsal paler, with two rows of longitudinal deep brown spots, pair on each membrane with upper about middle of fin and lower basal. Other fins all pale brownish. Two examples, 322 to 354 mm.

JOHNIUS NIGRITUS (Cuvier).

Head, 3¼ to 3⅓; depth, 3⅓ to 3⅗; D. X, I, 32 or 33; A. II, 6; tubes, 50 in lateral line to caudal base; 7 scales above lateral line to soft dorsal origin and 8 below to spinous anal origin; 32 predorsal scales to head; snout, 4⅓ in head from upper jaw tip; eye, 4 to 4⅓; maxillary, 2; interorbital, 4 to 4⅓. Elongately ovoid, well compressed, deepest at spinous dorsal base medially. Caudal peduncle strongly compressed, long as deep or least depth 4 to 4¼ in head. Head width, 2⅖ to 2¼ its length. Snout convex; length, ¾ its width. Eye slightly ellipsoid, advanced, hind edge about one-third of eye-diameter before center in head length. Mouth large; lower jaw very slightly projecting. Teeth simple, conic, in narrow bands in jaws, outer row of upper slightly enlarged or caninelike, lower reversed, though upper also with few inner slightly enlarged teeth in front. Maxillary to hind pupil edge; expansion, 1⅔ to 1⅘ in eye. Interorbital convex. Several inconspicuous or largely hidden serrae at preopercle corner. Rakers, II 7 to 9+13 II to V, lanceolate, longer than filaments, or 1¾ in eye. Scales narrowly imbricated, greatly crowded at predorsal, in oblique rows above and below lateral line; after anal below and largely above also parallel. Scales with 10 to 17 basal striae, circuli very fine and often complete, and apical denticles slender. Suprascapula with frayed cutaneous border. Row of smaller scales along soft dorsal base; also small scales on caudal base. Breast scales larger than predorsal. Tubes in lateral line large, greatly branched above and below from main vertical or oblique stem. Second dorsal spine 2 1/10 to 2⅛ in head, third ray 2⅔. Anal small, inserted much nearer caudal base than ventral origin, spines striate, second greatly enlarged and 1¾ to 2⅕ in head, second ray 1⅘ to 2. Caudal with long median point behind, 1⅛ to 1¼ in head; pectoral, 1¼; ventral, 1⅕ to 1¼.

Color in alcohol, back brown, sides and lower surface silvery-white. Each row of scales on back and upper sides with obscure median brownish streak. Iris whitish with dusky above. Fins largely pale

brownish; spinous dorsal dusky; soft dorsal with median deep brown longitudinal streak or two median parallel longitudinal streaks, and some scattered deep brown spots along base. Front part of soft anal, behind enlarged spine, dusted with deep brown. Caudal and pectoral dull brown, and ventral slightly yellowish. Two examples, 268 to 273 mm.

GALEOIDES DECADACTYLUS (Bloch).

Head, $2\frac{7}{8}$ to $3\frac{1}{4}$; depth, $2\frac{5}{6}$ to $3\frac{1}{5}$; D. VIII—I, 1, 13; A. III, 11; pectoral filaments, 9; scales, 43 to 45 in lateral line to caudal base and 6 more on latter; 6 scales above lateral line, 8 or 9 below; snout, $4\frac{4}{5}$ to $5\frac{1}{2}$ in head; eye, $3\frac{1}{4}$ to $4\frac{1}{8}$; maxillary, $2\frac{3}{5}$ to $2\frac{4}{5}$; interorbital, $3\frac{1}{8}$ to $3\frac{4}{5}$; rakers, 9 to 13+15 to 22. Scales finely ciliated, each with two basal radii and circuli fine. Four examples, 209 to 229 mm., of which two from Ashantee (p. 258).

LAGOCEPHALUS LAEVIGATUS (Linnæus).

Two young, from latitude 2° 33′ 22″ S.; longitude, 23° 57′ 15″ W

CEPHALACANTHUS VOLITANS (Linnaeus).

Seven very young, 25 to 60 mm., from same locality as the last. They are quite variable, and though the spines on the head all well developed, in largest but little shorter than head and not quite reaching far back as pectoral tip, in smallest twice length of pectoral and reaches half way to caudal base. Eye also greater than post-orbital in smallest. Compared and found to agree with other young Atlantic examples.

5. LIBERIA.

Besides the material in the United States National Museum are two small collections in the Academy of Natural Sciences of Philadelphia. The latter are of interest historically, apparently the first fishes ever collected in Liberia, and though several have been mentioned in scattered papers, the collections as a whole have never been examined and reported. The first of these comprise seven species Dr. S. M. E. Goheen gathered at Monrovia, and received at the Academy in the early forties. The other was made by the Rev. Thomas S. Savage at Cape Palmas, and donated to the Academy in 1847. The National Museum material includes the fishes obtained by O. F. Cook and G. N. Collins, at Mount Coffee, Monrovia, and that from the St. Pauls River at the same locality by Rolla P. Currie. In order to distinguish the various collections and their localities, the following letters indicate: G. (Goheen), S. (Savage), C. C. (Cook and Collins), and C. (Currie).

Concerning the literature several extensive papers have been contributed by Steindachner,[1] Hubrecht,[2] and Büttikofer.[3]

[1] Sitz. Ak. Wiss. Wien, vol. 55, 1867, pp. 517–526.— Notes Leyden Mus., vol. 16, 1894, pp. 1–96, pls. 1–4.
[2] Idem, vol. 3, 1881, pp. 61–71.
[3] Reisebilder aus Liberia, vol. 2, Die Bewohner Liberia's —Thierwelt Leyden, 1890, 510 pp (Fishes pp. 447–453).

NOTOPTERUS AFER Günther. "Plank Fish."

Head, 4; depth, $4\frac{3}{4}$; D. 1, 5; A. 134 (including caudal rays); scales in lateral line, about 147 to caudal base; 20 scales above lateral line to dorsal origin, and 33 below at same point; ventral serrae, 30+5; about 100 predorsal scales to head; snout, $4\frac{4}{5}$ in head; eye, $4\frac{4}{5}$; maxillary, $2\frac{1}{5}$; interorbital, $4\frac{1}{4}$. Body deepest at dorsal origin, strongly compressed. Head width, $2\frac{1}{2}$ its length. Snout, convex; length, two-thirds its width. Eye rounded, advanced about half its diameter before head center. Mouth large; lower jaw but little shorter. Maxillary to hind pupil edge. Row of moderate conic teeth in each jaw, also on vomer and palatines. Nasal flap about one-third of eye. Interorbital broadly convex. Lower preopercle edge finely serrate. Rakers 4+8, elongately clavate, two-fifths longer than filaments or about two in eye. Scales minute, generally in rows sloping down backward, smaller on head and densely crowded over anal and caudal. About 17 rows of scales on cheek. Scales with 14 to 16 basal radii; circuli moderate and usually complete. First branched dorsal ray $2\frac{3}{5}$ in head; caudal, $3\frac{1}{3}$; pectoral, $1\frac{2}{3}$. Color in alcohol largely deep brown, marked with ill-defined irregular spots about size of pupil, though few on anal. Head below and belly little paler, soiled with deep brown. Iris slaty. Length, 155 mm. C.

CLARIAS ANGOLENSIS Steindachner.

Head, $4\frac{1}{3}$; depth, 6; D. 74; A. 52; snout, 3 in head to hind edge of gill-opening; mouth width $2\frac{1}{4}$; interorbital, $1\frac{1}{5}$; eye, 5 in interorbital. Body moderately slender; profile somewhat fusiform. Head width equals its length, nearly smooth above. Snout broad; length in profile about two-fifths its width. Eye small; center about first fourth in head. Mouth broad, lips moderate; lower jaw much shorter. Broad bands of villiform teeth in jaws and on vomer; band of latter equally wide. Nasal barbel reaches slightly beyond occipital process; maxillary slightly beyond pectoral tip; outer mental slightly beyond end of pectoral spine and inner mental about to middle of latter. Frontal fontanel sole-shaped, twice broad as long and nearly twice length of occipital. Occipital process as slight isosceles triangle. Rakers, 4+12, lanceolate, about long as filaments, or $1\frac{1}{2}$ eye-diameters. Dorsal and anal not joined with caudal, but very narrowly separated. Dorsal begins at last two-fifths between pectoral and ventral origins. Body before anal shorter than rest of trunk by snout length in profile. Caudal $1\frac{2}{5}$ in head; pectoral, $1\frac{2}{3}$; ventral, $2\frac{1}{8}$. Pectoral spine serrate on both edges. Color in alcohol largely uniform brownish; belly but slightly paler. Dorsal and anal edges rather broadly and evenly whitish. Length, 98 mm. G.

The admission of this species to the Liberian fauna rests on the above determination, which was made with a comparison of Angola examples of equal size.

CLARIAS SALAE Hubrecht.

Head, 6 to 6½; depth, 7 to 10⅓; D. 80 to 92; A. 70 to 79; snout, 2⅜ to 2⅘ in head to hind edge of gill-opening; mouth width, 2 to 2⅖; interorbital, 1 9/10 to 2; eye, 6 to 8¾ in interorbital. Body slender, uniformly deep. Head, width 1¼ its length, above smooth, slightly granulate in half-grown. Snout broad; length about half its width. Eye very small, about first third in head. Mouth broad, with thick papillose lips; lower jaw shorter. Broad bands of villiform teeth in jaws and on vomer; band of latter slightly broader. Nasal barbel, seven-eighths to gill-opening above, or reaches it in half-grown; maxillary to pectoral tip, outer mental two-thirds of pectoral spine, and inner mental four-fifths to pectoral origin or reaching same in half-grown. Frontal fontanel sole-shaped, twice wide as long and nearly twice length of occipital fontanel. Both fontanels much smaller with age. Occipital process broad, short, scarcely beyond bony lateral processes of head. Rakers, 4+14, lanceolate, very slightly shorter than filaments, which about twice eye-diameter. Dorsal and anal joined slightly with membrane to caudal edge. Dorsal begins about last third between pectoral and ventral origins, or midway in half-grown. Body before anal one-third rest of trunk; 1½ in half-grown. Caudal, 1⅓ to 1½ in head; pectoral, 1½ to 2; ventral, 2½ to 2⅘. Pectoral spine serrate on each edge in half-grown; smooth with age. Uniform umber-brown above in alcohol, paler below and first all more or less dusky. Half-grown with about 17 transverse rows of small brown obscure spots on back and lower surface much paler. Length, 231 to 417 mm.; four examples. C.

CHRYSICHTHYS NIGRODIGITATUS (Lacépède).

Head, 3¼; depth, 4¾; D. I, 6; A. IV, 8, I; snout, 2⅖ in head; eye, 4⅕; maxillary, 3; interorbital, 3⅕. Body rather robust, compressed. Head width about 1⅔ its length. Snout, length about two-thirds its width, rather narrowed forward. Eye elevated, midway in head length. Mouth large, transverse, lower jaw much shorter. Lips thick, fleshy, papillose inside. Teeth villiform, in broad continuous bands in jaws. Elongate band of villiform vomero-pterygoid teeth, not continuous across roof of mouth. Nasal barbel about three-fifths of eye; maxillary barbel reaches back to dorsal origin; outer mental barbel to pectoral origin and inner mental two-thirds as far as outer mental. Interorbital slightly concave. Rakers, 10+16 lanceolate or nearly three-fifths of eye. Fins large; dorsal rounded or with first 3 rays longest; depressed fin, ⅝ to adipose fin. Adipose fin 2¼ in head; dorsal spine, 1½; pectoral spine, 1⅔, and inner edge of

last with about 14 antrorse serrae. Caudal large; lobes rather wide, deeply forked. Color in alcohol dull brown above; under surfaces all pale to whitish. Fins brownish. Iris slaty. One example 130 mm. long. C.

MALAPTERURUS ELECTRICUS (Gmelin).

Two examples from Mount Coffee. C.

MORMYROPS DELICIOSUS (Leach). "Dog-fish."

Head, $3\frac{3}{5}$; depth, $5\frac{2}{5}$; D. II, 24, 1; A. II, 42; scales 80 in lateral line to caudal base and 3 more on latter; 10 scales above lateral line to dorsal origin, 11 below to anal origin; 83 predorsal scales; snout $4\frac{2}{5}$ in head; mouth width 6; interorbital, $5\frac{3}{4}$. Elongate, well compressed, deepest at anal origin. Caudal peduncle small, well compressed, least depth $1\frac{3}{4}$ its length, or about $6\frac{1}{2}$ in head. Head conic, compressed; width 3 in its length. Snout convex, long as wide. Eye center near first fourth in head, 2 in snout. Mouth with short gape, broad, small, lower jaw much shorter. Teeth incisors, uniserial, ends very slightly notched medially. Interorbital convex. Scales largest in hind half of body, 14 around caudal peduncle. Scales with rather large reticulate striae, complete, about 16 basal and as many apical; also complete curculi fine. Caudal scaly over two-thirds its basal portion. Dorsal inserted slightly nearer caudal base than pectoral tip or about over first third of anal base, first branched ray about $2\frac{3}{5}$ in head. Anal inserted much nearer lower front edge of gill-opening than caudal base, first branched ray about $2\frac{3}{5}$ in head. Caudal small, well forked; lobes rather rounded, $2\frac{3}{5}$ in head; pectoral, 2; ventral, 3. Color in alcohol largely uniform deep chocolate-brown, each row of scales marked by median darker streak. Fins all dusky. Iris dull slaty. Length, 152 mm. C.

MORMYRUS GOHEENI, new species.

Head, $3\frac{2}{3}$; depth, $4\frac{1}{3}$; D. II, 58; A. III, 21; P. I, 14; V. I, 5; scales, 80 in lateral line to caudal base, and 5 more on latter; 13 scales above lateral line to dorsal origin and 12 below to anal origin; 31 predorsal scales; head width, $2\frac{2}{3}$ in its length; second branched dorsal ray, $2\frac{1}{6}$; fourth branched anal ray, $2\frac{2}{3}$; caudal, $1\frac{1}{2}$; pectoral, $1\frac{2}{3}$; ventral, $2\frac{1}{2}$; snout, $2\frac{1}{10}$ in head measured from upper jaw tip; eye, $8\frac{1}{4}$; interorbital, $6\frac{2}{3}$; least depth of caudal peduncle, $6\frac{1}{4}$.

Body elongately ovoid, with back slightly elevated; predorsal slightly trenchant and greatest depth at dorsal origin. Caudal peduncle slender, well compressed; least depth, $2\frac{2}{3}$ its length.

Head long and pointed, compressed. Muzzle tubular; least depth, $3\frac{1}{8}$ in snout, length measured from its own tip. Eye ellipsoid, rather high, its front edge about midway in head length, without lids or skin of head extending over. Lips spongy, large, and lower

as broad flap protruding in front. Teeth, 6 incisors above and 6 below, each with notched edges. Nostrils small, simple pores close together, slightly behind last third in snout length. Interorbital convex.

Gill-opening lateral, about $1\frac{1}{2}$ in snout. Rakers, 4 + 7 short rudimentay tubercles, and gill-filaments about equal eye.

Scales all narrowly imbricated, in rows sloping upward posteriorly, largest on caudal peduncle, around which 12, and closely crowded on predorsal. Caudal scaly, most scales large, edges broadly naked. Head covered with numerous pores. Scales with fine complete circuli, basal striae 24 to 27 and apical striae reticulate, incomplete medially in smaller scales. Lateral line median along side; scales small and tubes arborescent on trunk.

Dorsal inserted nearer snout tip than last anal ray base; fin slightly higher in front. Anal begins about midway in dorsal base; front branched rays highest. Caudal forked, pointed lobes about equal.

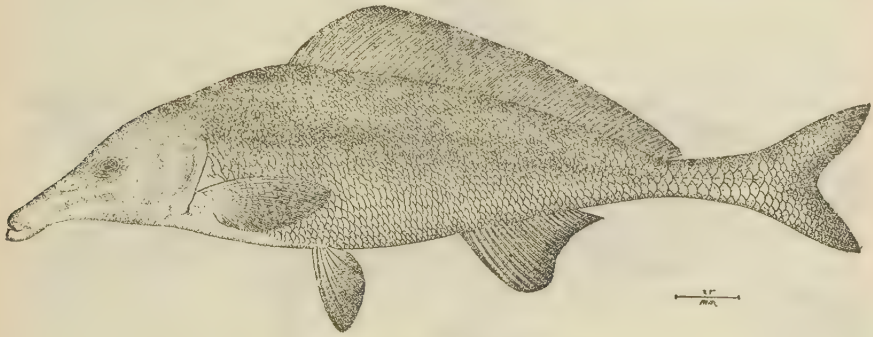

FIG. 7.—MORMYRUS GOHEENI.

Pectoral broad, extends back one-fifth in depressed ventral. Latter inserted very slightly behind dorsal origin; fin, $1\frac{3}{4}$ to anal. Vent close before anal.

Color in alcohol largely dull dusky-brown, mostly uniform. Dorsal with median longitudinal brownish band obscurely. Outer portions of caudal lobes, front of anal, and ends of paired fins with dusky to blackish tints. Iris slaty. Head, belly, and basal portion of pectoral paler than upper surfaces.

Length, 345 mm.

Type.—Cat. No. 48517, U.S.N.M. St. Paul's River, Liberia. Rolla P. Currie.

Also Cat. Nos. 48514 to 48516, and 48518, same data, paratypes. These have: head, $3\frac{3}{5}$ to $3\frac{5}{6}$; depth, 4 to $4\frac{2}{5}$; D. II, 56 to II, 59; A. II or III, 18 to 21; scales, 80 or 81 in lateral line to caudal base and 2 to 4 more on latter; 14 to 17 scales above lateral line to dorsal origin and 11 to 14 below; 32 to 36 predorsal scales; scales, 12 or 13 around

caudal peduncle; snout, $2\frac{1}{10}$ to $2\frac{1}{6}$ in head, measured from its own tip; eye, 7 to $8\frac{2}{3}$; interorbital, $5\frac{1}{3}$ to $5\frac{7}{8}$; least depth in snout length, $2\frac{3}{4}$ to $3\frac{2}{3}$; length, 295 to 334 mm.

This species is related to *Mormyrus caballus* Boulenger and *Mormyrus tapirus* Pappenheim, the former from the Kongo and the latter from Kamerun. The former differs in a more robust and nontubular snout and longer pectoral. It agrees with the Kamerun species in the tubular snout and pectoral, but differs in details of fin rays, and from both species it differs in the larger scales.

(For Dr. S. M. E. Goheen, the first to collect fishes in Liberia.)

LABEO CURRIEI, new species.

Head, $3\frac{2}{3}$; depth, $3\frac{1}{3}$; D. II, 10; A. III, 5; P. I, 17; V. I, 8; scales, 32 in lateral line to caudal base and 4 more on latter; 5 scales above

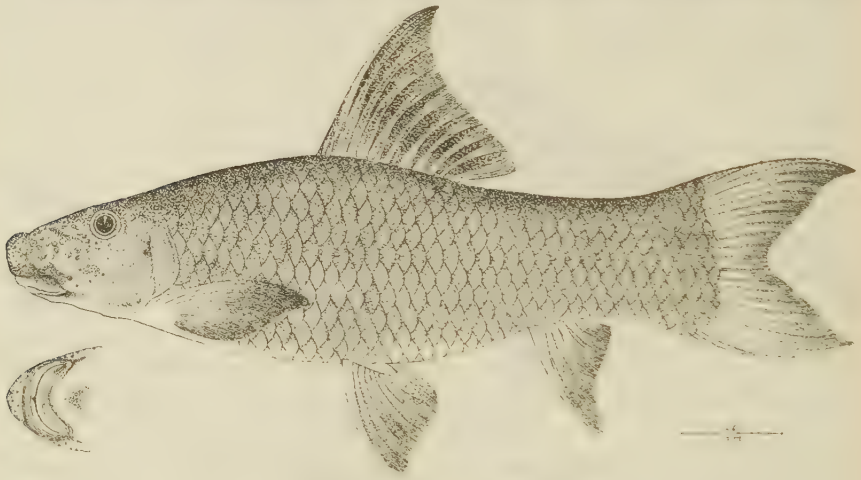

FIG. 8.—LABEO CURRIEI.

lateral line to dorsal origin and 5 below to anal origin; predorsal scales, 13; head width, $1\frac{1}{2}$ its length; head depth at occiput about $1\frac{1}{3}$; snout, $1\frac{7}{8}$; eye, $5\frac{3}{4}$; maxillary, $1\frac{7}{8}$; interorbital, $2\frac{1}{3}$; first branched dorsal ray, $1+\frac{1}{10}$; first branched anal ray, $1\frac{1}{3}$; upper caudal lobe, $1+\frac{1}{4}$; pectoral, $1\frac{1}{8}$; ventral, $1\frac{1}{3}$; least depth of caudal peduncle, $1\frac{1}{2}$.

Body deep, with robust contour, compressed, deepest at dorsal origin, and edges all convex. Caudal peduncle deep, compressed strongly; length about three-fifths its least depth.

Head moderate, compressed; cheeks not much swollen. Snout broad, convex over surface, long as wide. Eye small, front edge about midway in head length, supero-lateral, entirely visible from above but not below. Mouth broad, slightly crescentic as seen below; lower jaw greatly inferior. Maxillary to hind nostril. Lips thick, fleshy, inner surface formed with transverse plicae made up of

papillae. Small barbel near end of maxillary largely concealed. Each jaw edge as firm, entire horny sheath. Nostrils together, separated by short skinny flap, at last fourth in snout. Interorbital broad, slightly convex.

Gill-opening forward nearly to hind eye edge. Rakers, about 16+65, weak, flexible, 3 in filaments and latter about equal eye. Pharyngeal teeth, 2, 4, 5—5, 4, 2, each with broad grinding surfaces and no terminal hook. Each pharyngeal arch with an outer row of four extra deciduous teeth; these more obtuse and without grinding surfaces.

Scales large, rather narrowly uniform in exposure; scarcely smaller on caudal base, though much more so on breast, so about 18 transversely across between pectoral origins. Free pointed scaly ventral flap about two-fifths of fin. Scales finely striate, about 24 to 28 basal and 60 to 70 apical, circuli all very fine but not complete apically. Lateral line midway along side, complete, inconspicuous, nearly straight, and with small simple tubes.

Dorsal origin about midway between snout tip and caudal base, upper edge concave, first branched ray longest and extends far back as tip of last or $1\frac{2}{3}$ to caudal base. Anal inserted about opposite tip of depressed dorsal, fin falcate, with first branched ray longest and reaching slightly beyond caudal base, though not quite to hind limit of caudal squamation. Caudal deeply forked, lobes pointed and upper little longer; fin large. Pectoral moderate, extends three-fourths to ventral. Latter inserted about opposite third branched dorsal ray base, and fin three-fourths to anal, though not quite to vent.

Color in alcohol deep dusky-brown, paler or more brownish below, on belly, and under surface of head. On sides and back edges of each scale slightly darker than general color. Lips pale. Fins all dusky, and on lower fins more or less dusky blackish on outer portions with narrowed paler edges. Iris dull slaty.

Length, 210 mm.

Type.—Cat. No. 48512, U.S.N.M. St. Pauls River, Liberia. Rolla P. Currie.

Also No. 48513, same data, in all three paratypes. These show: head, $3\frac{1}{2}$ to $3\frac{2}{3}$, depth, $3\frac{1}{6}$ to $3\frac{1}{3}$; D. III, 10 or III, 11; A. II, 5 or 6; scales, 30 to 32 in lateral line to caudal base and 3 or 4 more on latter; 5 scales above lateral line and 5 below; 10 or 11 predorsal scales; snout, $1\frac{7}{8}$ to 2 in head; eye, $5\frac{3}{4}$ to 7; maxillary, 2 to $2\frac{1}{3}$; interorbital, $2\frac{1}{5}$ to $2\frac{2}{3}$; length, 154 to 180 mm.

This species falls with *Labeo nasus* Boulenger and *Labeo greenii* Boulenger, both from the Kongo, according to Boulenger's key, as it has 16 or 17 scales around the caudal peduncle. It differs from either, however, in the more obtuse snout, which, though finely

tubercular, is not turned upward; deeper body, larger scales, and darker color.

(For Rolla P. Currie, who obtained the types.)

HYDROCYNUS FORSKALII Cuvier.

Head, 3½; depth, 4¼; D. II, 8; A. III, 13; scales 44 in lateral line to caudal base and 4 more on latter; 8 scales above lateral line, 3 below to ventral, and same below to anal; 19 predorsal scales; snout, 2⅞ in head from upper jaw tip; eye, 4⅔; maxillary, 2½; interorbital, 3½. Elongate, compressed, deepest at dorsal origin. Caudal peduncle compressed; least depth, 1⅔ its length, or 2⅔ in head. Head well compressed, sides flattened; width, about 2¼ its length. Snout, conic, long as wide. Eye, high, covered with broad adipose lid in front and behind; hind pupil edge about midway in head length. Mouth, rather large, with powerful convex jaws, lower little protruded. Upper jaw with 10 and lower with 8 large teeth. Maxillary largely concealed below broad suborbital, reaches pupil. Nostrils together, hind one about last fourth in snout. Interorbital broad, very slightly convex. Rakers, II, 3+10 II, lanceolate, about two-thirds of filaments and latter 1⅘ in eye. Scales mostly uniform, in even lengthwise rows, but little smaller on caudal base. Free pointed axillary ventral scaly flap about two-fifths of fin. Scales with fine even basal circuli and one basal ray. Lateral line largely straight, decurved suddenly from shoulder, low along caudal peduncle side. Tubes slender, well exposed, simple. Dorsal origin midway between mandible tip and caudal base; first branched ray 1⅔ in head; adipose fin, 4. Anal inserted slightly nearer caudal base than ventral origin; first branched ray about 2 in head. Caudal deeply forked, long slender lobes about an eye-diameter longer than head, pectoral 1⅔, ventral, 1¾. Color in alcohol, dull brown, paler below. Narrow blackish brown longitudinal streak along each row of scales on trunk. Dorsals and caudal with outer or hind edges dusky gray, and median portion of lower caudal lobe tinged with same. Lower fins brownish, median portions brighter brownish. Iris, slaty. Length, 237 mm. C.

ALESTES LONGIPINNIS Günther.

Head, 3½ to 3⅔; depth, 2½; D. II, 8; A. III, 18; scales, 27 to 30 in lateral line to caudal base and 3 more on latter; 6 scales above lateral line, 3 below; 12 or 13 predorsal scales; snout, 3¼ to 3⅓ in head; eye, 3¼ to 3⅓; maxillary, 2¾ to 3; interorbital, 2⅗ to 2⅔. Deeply ellipsoid, compressed, deepest at dorsal origin. Head width 1⅘ to 2 in its length. Snout conic, length three-fourths its width. Eye advanced, hind pupil edge about midway in head length. Maxillary to eye, largely concealed. Mouth broad, short, gape not quite half way to eye; jaws about even. Upper teeth 6+8, lower

8+2. Nostrils together, at last two-fifths in snout. Interorbital convex. Lower suborbital meets horizontal preopercle limb, and others leave but very narrow naked strip on cheek in front and behind at corner. Rakers, 8+14, lanceolate, weak, about three-fifths of filaments and latter about $1\frac{4}{5}$ in eye. Scales large, well exposed, each with 4 basal striae, 1 above and another below as vertical, and pair of apical. Dorsal inserted midway between nostrils and caudal base, first 4 branched rays prolonged and filamentous, and third nearly to caudal base. Adipose fin about long as eye. Anal inserted close behind dorsal base, first branched ray 2 to $2\frac{1}{3}$ in head. Caudal well forked, lower lobe slightly longer, $\frac{1}{4}$ to $\frac{1}{2}$ eye-diameter longer than head, pectoral $1\frac{1}{6}$ to $1\frac{1}{4}$, ventral, $1\frac{1}{5}$. Color in alcohol with back brown; side and below pale or whitish. Large black blotch on caudal peduncle extends out and includes median caudal rays. Fins all pale; dorsal and caudal each with some brownish on membranes. Length, 111 to 113 mm. Two examples. C.

The dorsal rays end in long filaments, nearly long as rest of the fin in male.

ALESTES RUTILUS Boulenger.

Head, $3\frac{1}{2}$; depth, $3\frac{1}{3}$; D. II, 8; A. III, 13; scales, 22 in lateral line to caudal base and 2 more on latter; 5 scales above lateral line, 2 below; 8 predorsal scales; snout, 3 in head; eye, $3\frac{3}{4}$; maxillary, 3; interorbital, $2\frac{1}{4}$. Deeply ellipsoid, well compressed, deepest at dorsal origin. Head, width $1\frac{4}{5}$ its length. Snout broadly conic; length, four-fifths its width. Eye advanced, hind pupil edge about midway in its length. Maxillary well exposed, not to eye or only to hind nostril. Mouth, broad, short, gape about two-fifths to eye; lower jaw slightly shorter. Upper teeth, 10+8; lower, 8+2. Nostrils together about last third in snout. Interorbital convex. Lower suborbital meets horizontal preopercle limb, and others leave narrow naked strip on cheek in front and behind at corner. Rakers, 14+16, lanceolate, about three-fourths of filaments and latter 2 in eye. Scales very large, well exposed, each with 4 basal striae, 1 above and another below as vertical, and 4 or 5 apical. Dorsal inserted about midway between hind eye edge and caudal base; first branched ray, $1\frac{1}{4}$ in head; adipose fin, $4\frac{4}{5}$. Anal inserted well behind dorsal base but close before last ray's tip, first branched ray $1\frac{3}{4}$ in head. Caudal well forked, about $1+\frac{1}{6}$ in head; pectoral, $1\frac{1}{4}$; ventral, $1\frac{2}{3}$. Color in alcohol with back brown, paler below, edge of each scale on back narrowly darker. Obscure dusky blotch on caudal base within squamation. Dorsal and caudal brownish, with dusky on outer portions. Other fins pale with brownish on outer portions, dusky on anal. Iris olive-slaty. Length, 150 mm. C.

This differs from Boulenger's account in the median caudal rays with a pale shade and obscure blotch of darker at caudal base.

HOLOPTERURA PLUMBEA Cope.

Holopterura plumbea Cope, Trans. Amer. Philos. Soc. Phila., (2) vol. 14, 1871' p. 482. West Africa.

Head, 8; depth, $32\frac{2}{3}$; snout, $6\frac{7}{5}$ in head; eye, $9\frac{3}{4}$; maxillary, $3\frac{1}{3}$; interorbital, 8; mandible, $2\frac{4}{5}$; pectoral, 6; about 114? pores distinct in lateral line; head, $3\frac{2}{5}$ to vent. Compressed, elongate, sides rather flattened, and tail gradually tapers behind but not acuminate at tip. Head moderately compressed; pharynx scarcely swollen, profiles similar; width, $4\frac{1}{2}$ its length; depth, $3\frac{2}{3}$. Snout conic; upper profile and surface convex; basal width, $1\frac{1}{6}$ its length; tip projecting well beyond mandible. Eye large, rather ellipsoid, without eyelid, center trifle before first fifth in head. Mouth large, broad, horizontal, or but slightly inclined. Lips fleshy, entire, rather thick. Teeth conic, sharp pointed, mostly directed back, moderate in size, not continuous above with premaxillary or vomerine series. Upper lateral teeth biserial. Mandibular teeth similar, continuous across symphysis. Several rather large premaxillary teeth, visible from below

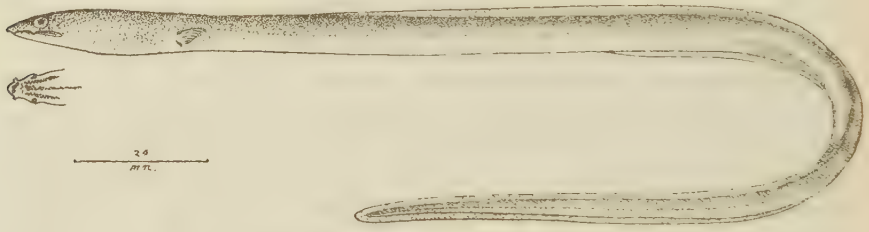

Fig. 9.—Holopterura plumbea Cope.

in closed mandible. Vomerine teeth like upper laterals, beginning just behind front nostril, biserial, conic, slope backward and anterior little enlarged. Most all teeth little larger anteriorly in jaws. Tongue not evident. Mandible shallow; surface rather depressed, rami low. Front nostril in small tube on upper lip opposite closed mandible tip. Hind nostril deep slit in upper lip opening downward below front eye edge. Interorbital convex. Gill-opening inclined in crescent from opposite upper median pectoral rays obliquely back, about equals eye. Skin rather smooth, with more or less distinct longitudinal wrinkles on lower surface of head and pharynx. Pores on head little evident. Lateral line begins above on head little before middle in latter's length, slightly elevated at first along side of trunk, soon median, ends short space before tail tip. Dorsal origin distant from gill-opening, equals space between gill-opening and front eye edge; fin low, continuous with low caudal behind. Caudal length about three-fourths in eye. Anal, like dorsal, joins caudal behind. Pectoral small, upper ray longest. Vent close before anal. Color in alcohol largely brownish, obscurely dotted with darker. Head above

like back, pale below. Iris pale slaty. Fins all pale brown. Length, 232 mm.

No. 22964 A. N. S. P., type of *H. plumbea* Cope. West Africa. Dr. S. M. E. Goheen.

Cope says, "Anterior nostrils (posterior in position) concealed within the lip in front of the eye; posterior nostrils tubular, deflected and posterior to the apex of the muzzle," though I find them as described above. Further, the "branchial slits approximated below the small pectoral fins" are not more so than in related genera. Cope also says, "No canines," though most of the anterior teeth are a little enlarged. None of the teeth is hardly "one-rowed behind" except perhaps at the extreme hind areas, where they are very small.

OPHICHTHUS RUFUS (Rafinesque).

One example, 349 mm. It agrees with four examples from Italy in every respect except the minor character of a thicker snout, which doubtless a condition of preservation. C. C.

ECHIDNA PELI (Kaup).

Three examples, 274 to 504 mm. G.

APLOCHEILUS SPILAUCHEN (A. Dumeril).

Twenty-seven examples. C.

SCOMBEROMORUS ARGYREUS Fowler.

Scomberomorus argyreus Fowler, Proc. Acad. Nat. Sci. Phila., 1904, p. 764, pl. 51, lower fig. "West Africa."

Type.—No. 11400, A.N.S.P., examined. S.

CARANX AFRICANUS Steindachner.

One example, 248 mm. S.

TRACHINOTUS GOREENSIS Cuvier.

One example, 183 mm. S.

CHLOROSCOMBRUS CHRYSURUS (Linnaeus).

Chloroscombrus hesperius Fowler, Proc. Acad. Art. Sci. Phila., 1906, p. 114, fig. 1. West Africa.

The type of *C. hesperius*, No. 11198, A.N.S.P., examined. S.

GALEOIDES DECADACTYLUS (Bloch).

One example. 162 mm. S.

ANABAS KINGSLEYAE (Günther).

Head, $2\frac{3}{4}$; depth, $2\frac{2}{5}$; D. XVI, 10; A. IX, 10; scales, 17 in upper section of lateral line and 8 in horizontal section to caudal base;

3 scales above upper lateral line to spinous dorsal origin and 9 below to spinous anal origin; 15 predorsal scales; snout $3\frac{7}{8}$ in head from upper jaw tip; eye, $3\frac{7}{8}$; maxillary, 3; interorbital, 3. Well compressed, deepest medially, caudal peduncle not developed or rudimentary. Head width nearly half its length. Snout broadly conic, length $\frac{4}{5}$ its width. Eye round, hind edge midway in head length. Mouth small, moderately inclined; lower jaw very slightly protruded. Maxillary to eye. Bands of small conic teeth in jaws, front ones little longer, none on mouth roof. Interorbital convex. Preorbital and preopercle entire; hind edges of opercle and subopercle spinescent. Rakers, 5 short firm points, half of filaments, which about two-fifths of eye. Scales with about 22 basal striae and fine circuli, all finely ctenoid. All rayed vertical fins densely scaled over greater portions basally. Cheek with five rows of scales. Tubes in lateral line simple, well exposed, not out over caudal base. Last dorsal spine $2\frac{5}{6}$ in head; sixth dorsal ray, $1\frac{5}{6}$; last anal spine, $2\frac{7}{8}$; sixth anal ray, $1\frac{7}{8}$; caudal, $1\frac{1}{3}$; pectoral, $1\frac{1}{2}$; ventral, 2. Color in alcohol dark brown generally. Round blackish blotch at end of lower lateral line over two scales at least. Head below and breast dull brown. Iris slaty. Length, 84 mm. C.

TILAPIA GALILAEA (Linnaeus).

Head, $2\frac{1}{2}$ to $2\frac{3}{4}$; depth, 2 to $2\frac{1}{2}$; D. XV, one XIV, 12 to 14; A III, 11 or 12; scales, 19 in upper section of lateral line, 11 or 12 in lower section to caudal base, and 2 more out on latter; 4 scales above upper section of lateral line to spinous dorsal origin, 10 below to spinous anal origin; predorsal scales, 10 to 13; snout, $2\frac{4}{5}$ to 3 in head; eye, $3\frac{1}{4}$ to $3\frac{1}{2}$; maxillary, $3\frac{2}{5}$ to $3\frac{3}{4}$; interorbital, 3 to $3\frac{1}{3}$. Head width, 2 in its length. Snout convex; length, long as width or little less. Maxillary very slightly beyond nostril, well short of eye. Teeth rather slender, incisor-like; ends notched; outer rather large. Interorbital little convex. Rakers, 4+20, short, lanceolate, about 2 in filaments and latter $1\frac{3}{4}$ in eye. Scales cycloid, extend on caudal basally. Circuli moderate, mostly complete, basal radii 13 or 14 and apical denticles slightly developed or short. Fourth dorsal spine about $2\frac{1}{2}$ in head; third anal spine, $2\frac{3}{5}$ to $2\frac{3}{4}$; caudal, $1\frac{1}{6}$ to $1\frac{1}{4}$; pectoral, $1\frac{1}{10}$; ventral spine, $2\frac{1}{8}$ to $2\frac{2}{5}$. Color in alcohol brownish, paler below, with about seven indistinct darker brownish bands on back above. Fins all pale, with dark blotch at origin of soft dorsal and two or three oblique dark streaks on latter forward. Caudal slightly emarginate, with hind edge dusky. Length, 55 to 66 mm. Three examples. C.

TILAPIA HEUDELOTI A. Dumeril.

One adult. C.

TILAPIA SAVAGEI, new species.

Head, 3; depth, $2\frac{2}{5}$; D. XV, 13; A. III, 9; P. I, 13: V. I, 5; scales, 22 in upper section of lateral line, 10 in lower section to caudal base, and 2 more out on latter; 5 scales above upper section of lateral line to spinous dorsal origin, 9 below to spinous anal origin; 11 predorsal scales; head width, $1\frac{1}{4}$ its length; snout, 3; eye, 4; maxillary, $2\frac{4}{5}$; interorbital $3\frac{2}{5}$; last dorsal spine, $1\frac{9}{10}$; fourth dorsal ray, 1; third anal spine, $2\frac{1}{6}$; third anal ray, 1; least depth of caudal peduncle, $2\frac{1}{8}$; pectoral, $1\frac{1}{6}$; ventral spine, $2\frac{7}{8}$.

FIG. 10.—TILAPIA SAVAGEI.

Body elongately ellipsoid in contour, deepest at ventral spine tip; edges all convex, well compressed. Caudal peduncle well compressed; length, about two-thirds of least depth.

Head compressed, flattened sides converging about evenly above and below. Snout conic, surface convex, long as wide. Eye little ellipsoid; center nearly midway in head length and but little elevated. Mouth small, gape about two-thirds to eye, and lower jaw very slightly shorter. Maxillary beyond nostril, but not to eye; expansion $2\frac{1}{8}$ in latter. Lips firm. Teeth in about five rows above and three below, with outer row in each jaw largest, moderately slender, expanded and notched at ends. Nostril simple pore at last two-fifths in snout. Interorbital broad, slightly convex. Preopercle and preorbital edges entire; width of latter, about $1\frac{1}{5}$ in eye.

Gill-opening forward about to front eye edge. Rakers, 2+14, lanceolate, short or about one-third in filaments and latter two in eye. Isthmus narrowly triangular.

Scales large, cycloid, rather well exposed, small on breast or about 25 rows before ventral. Caudal covered with small scales over basal half; other fins naked. Cheek with four rows of scales. Scales with complete fine circuli and 11 basal converging radii. Upper section of lateral line slightly convex, and lower begins 2 scales before terminus of upper. Tubes all simple and well exposed.

Spinous dorsal inserted behind pectoral base; spines all graduated up toward last, which longest; fin edge notched and small skinny flap from behind tip of each spine. Soft dorsal with rays all graduated up to fourth or longest, which form slender point extending back about opposite first two-fifths in caudal. Spinous anal inserted opposite soft dorsal origin, graduated to third or longest ray which forms slender filament extending back to middle of caudal. Caudal with hind edge truncate. Pectoral with upper rays longest, three-fourths to anal. Ventral inserted close behind pectoral base, first branched ray ending in long filament reaching base of third anal spine. Vent about half an eye-diameter before anal.

Color in alcohol dull brownish generally; lower surfaces of head and trunk paler. Nine broad dusky brown transverse bands over back; first connecting eyes and those on trunk extended down opposite pectoral base. Opercle with conspicuous rounded black spot little smaller than eye. Dark band from lower front eye edge to end of maxillary. At front of soft dorsal basally large black blotch. Also dusky-brown horizontal band, much narrower than any of vertical ones, extends from behind opercular dark blotch to caudal base medially. Vertical fins dull brownish-dusky leaving pale obscure blotches, and other fins pale. Iris slate. Lower lip pale.

Length, 128 mm.

Type.—Cat. No. 48504, U.S.N.M. St. Paul's River, Liberia. Rolla P. Currie.

Also No. 48,503, including four examples, same data, paratypes. These show: head, 3 to $3\frac{1}{5}$; depth, $2\frac{3}{5}$ to $2\frac{1}{2}$; D. XV or XVI, 13; A. III, 9 or 10; scales, 21 or 22 in upper section of lateral line; 8 or 9 in lower section to caudal base and 2 more on latter; 5 scales above lateral line and 10 below; snout, $2\frac{1}{2}$ to $2\frac{7}{8}$ in head; eye, $3\frac{1}{4}$ to $3\frac{2}{5}$; maxillary, 3 to $3\frac{1}{8}$; interorbital, 3 to $3\frac{1}{8}$. Snout long as broad or little smaller in younger examples. Maxillary to eye in young slightly shorter or not much beyond eye with age. Last dorsal spine, $1\frac{9}{10}$ to 2 in head; fourth dorsal ray, $1\frac{1}{6}$ to $1\frac{2}{5}$; third anal spine, $2\frac{1}{8}$ to $2\frac{1}{6}$; third anal ray, 1 to $1\frac{1}{4}$; caudal, 1 to $\frac{1}{10}$; pectoral, $1\frac{1}{6}$ to $1\frac{1}{4}$; ventral spine, $1\frac{7}{8}$ to $2\frac{1}{3}$. Length, 90 to 116 mm.

Related to *Tilapia brevimanus* Boulenger, from Portuguese Guinea, in contour, cheek scales, dentition and squamation generally. It differs, however, in the presence of a horizontal dark median band, deeper body, rather fewer dorsal spines, mostly more anal rays, and longer pectoral.

(For the Rev. Thomas S. Savage, who collected fishes many years ago in Liberia.)

TILAPIA BÜTTIKOFERI (Hubrecht).

Head, $2\frac{3}{4}$ to $2\frac{7}{8}$; depth, 2 to $2\frac{1}{6}$; D. XIV or XV, 16 or 17; A. III, 11 or 12; scales, 21 or 22 in upper section of lateral line, 11 to 13 in lower section to caudal base, and 2 or 3 more on latter; predorsal scales, 14 or 15; snout, $2\frac{2}{5}$ to 3 in head; eye, $3\frac{1}{2}$ to 5; maxillary, 3 to $3\frac{2}{5}$; interorbital, $2\frac{1}{2}$ to 3. Body well compressed; contour deeply ellipsoid, deepest at end of ventral spine. Caudal peduncle compressed; length, $1\frac{3}{4}$ to 2 in its least depth and latter 2 in head. Head width, $1\frac{4}{5}$ to $1\frac{7}{8}$ in its length. Snout broad as long; length, four-fifths its width in young. Eye little elevated, about midway in head length, slightly advanced in young. Mouth moderate, terminal, jaws about even. Maxillary slightly beyond nostril; expansion about $1\frac{1}{4}$ in eye. Teeth in strong outer row in each jaw, truncate, and with two inner rows above and below inside inconspicuous. Young with outer teeth more notched and single inner row above and below. Interorbital convex. Rakers, 4+10 or 11 short strong points, about 2 in filaments, and latter $1\frac{7}{8}$ in eye. Scales, large, cycloid, circuli very fine and about 14 radiating basal radii, 11 in young. Caudal scaly over basal two-thirds, at least on membranes of fin. Cheek with five rows of scales; vertical diameter of cheek below eye equals $1+\frac{1}{4}$ eye-diameters. Tubes in lateral line simple, over entire scale exposure. Last dorsal spine, $1\frac{4}{5}$ in head (2 in young), sixth dorsal ray, $1\frac{1}{8}$ ($1\frac{2}{5}$ in young); third anal spine, $2\frac{2}{5}$ ($2\frac{1}{8}$ in young). Caudal truncate, slightly convex when expanded, $1\frac{1}{4}$ in head ($1\frac{2}{5}$ in young); pectoral, $1\frac{1}{6}$ ($1\frac{1}{3}$ in young); ventral spine, $2\frac{1}{6}$ (2 in young). Color in alcohol dull brownish generally, with 8 broad blackish vertical bands, meeting below, first through eye and last at caudal base. Pectoral pale brownish; other fins mostly blackish; all with pale edges. Young with broad dusky bands reflected on vertical fins, so that soft dorsal and anal with three dark transverse blotches or streaks; basal much larger and black. Also young usually with another transverse black band across caudal near base. Black blotch at corner of opercle little smaller than eye, and all with conspicuous black blotch at origin of soft dorsal where transverse dark band crosses. Iris slaty. Length, 75 to 245 mm.; three examples.

These differ from Boulenger's examples slightly,[1] the adult having the long ventral filaments extending back beyond anal base, but

[1] Cat. Fresh Water Fish, Africa, vol. 3, 1915, p. 214, fig. 138.

little short of last anal ray tip. An example in the Academy, 58 mm. long, from "West Africa," without donor is doubtless from Goheen or Savage.

HEMICHROMIS FASCIATUS Peters.

Hemichromis auritus GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 135.

Head, 2⅔ to 2⅚; depth, 2¾ to 2⅝; D. XIV, sometimes XV, rarely XIII, 11, sometimes 12; A. III, 9; upper branch of lateral line, 16 to 20 scales; lower section, 9 to 12 to caudal base and 1 to 3 more on latter; 4 scales above lateral line to spinous dorsal origin, 9 scales below to spinous anal origin, rarely 10; predorsal scales, 9 to 11; snout, 2⅘ to 3⅛ in head, measured from upper jaw tip; eye, 3⅔ to 4⅖; maxillary, 2⅗ to 3; interorbital, 3 to 3⅔. Elongately ellipsoid, deepest at sixth dorsal spine base. Caudal peduncle well compressed; length about three-fourths its least depth and latter 2½ in total head length. Head width, 2⅛ its length. Snout conic, slightly longer than broad, or broad as long in young. Eye little elevated, hind pupil edge midway in head length, slightly advanced in young. Maxillary about to eye, expansion about two-thirds of pupil. Teeth conic, uniserial below and above, upper outer series well separated from much smaller inner row; latter absent in young. Interorbital broadly convex. Rakers, 1 or 2+8 to 10, anvil-shaped, about two-thirds of filaments and latter 1½ in eye. Scales large, cycloid, extend out over two-thirds of caudal; circuli fine and incomplete apically; basal radiating striae, 10 or 11. Cheek with 4 or 5 rows of scales. Small scales on breast like those on caudal base. Spinous dorsal begins before pectoral; last spine, 2½ to 2⅔ in head; sixth dorsal ray, 1⅔ to 2⅓. Anal begins about midway between pectoral origin and caudal base; third spine about 3 in head; fourth anal ray, 1⅔ to 2¼. Caudal convex behind, truncate in some examples, 1¼ to 1⅓ in head; pectoral, 1⅗ to 1¾; ventral, 1⅔. Color in alcohol generally dull brownish above, paler to whitish below, sides with five large vertical blotches of black, continued up over back narrower and paler, and between them on side medially each scale with brownish blotch at hind edge. Black blotch on opercle little smaller than eye, with brownish area forward to latter. Iris gray-brown; soft vertical fins often with few pale spots or blotches basally, upper caudal corner and edge of soft dorsal sometimes whitish. Iris brownish. Length, 60 to 162 mm. One from Liberia (C.) also type of *Hemichromis auritus* Gill (S.), and 15 from Angola, as listed further on.

HEMICHROMIS BIMACULATUS Gill.

Head, 2⅔ to 2¾; depth, 2¾ to 2⅞; D. XIV, rarely XIII or XV, 11, rarely 10; A. III, 8, rarely 7; scales 17 to 19 in upper section of lateral line, 8 to 11 in lower section to caudal base, and 2 more on latter; 3 or 4 scales above lateral line to spinous dorsal origin, 9 or 10

below to spinous anal origin; 11 or 12 predorsal scales; snout, 3⅛ to 3⅓ in head from upper jaw tip; eye, 3¾ to 4; maxillary, 2⅞ to 3; interorbital, 3⅔ to 4. Elongately ellipsoid, deepest opposite ventral spine tip. Caudal peduncle well compressed; length about three-fourths its least depth and latter 2⅛ to 2¼ in total head length. Head width, 2 to 2⅛ its length. Snout conic, long as broad or length slightly less with age. Eye slightly elevated; hind pupil edge about midway in head length, slightly advanced in young. Mouth moderate, lower jaw slightly protruded. Teeth conic, mostly uniserial, sometimes inner row of small obscure ones above and well back. Interorbital broadly convex. Rakers 3+5, anvil-shaped, about 2 in eye. Scales large, cycloid, out over caudal at least halfway basally, with fine circuli incomplete apically and 10 or 11 basal radiating striae. Cheek with 3 or 4 rows of scales. Small scales on breast like those on caudal base. Spinous dorsal inserted opposite pectoral origin; last spine, 2⅞ to 3¼ in head, sixth ray 1⅘ to 2. Spinous anal midway between ventral origin and caudal base; third spine, 3, fourth ray, 2 to 2⅛. Caudal convex behind, 1⅓ in head; pectoral, 1⅔ to 1½; ventral 1⅗ to 1¾. Color in alcohol brown above with olive tint; below, paler to whitish. Black blotch nearly large as eye on opercle; another just before anal and usually third at caudal base. Median dark, usually lengthened as vertical streaks and 5 dark leaden vertical streaks across back in front of it and as many more toward tail. Fins largely pale brownish, uniform. Iris brownish. Length, 60 to 108 mm. Nine examples (C.), and one (C. C.).

DREPANE PUNCTATA (Linnaeus).

Cryptosmilia luna COPE, Trans. Amer. Philos. Soc. Phila., ser. 2, vol. 13, 1867, p. 401. "Western African seas."

Head, 3; depth, 1; D. I, IX, 21; A. III, 17; scales 44 (pockets) in lateral line to caudal base and 4 more on latter; 12 scales above lateral line, 30 below to anal origin; snout, 2⅔ in head; eye, 3; maxillary, 3¾; interorbital, 4. Deeply rhomboid, greatly compressed, least depth of caudal peduncle, 2¾ in head. Head width 2 in its length. Snout compressed, width 1⅔ its length. Eye well elevated, advanced. Mouth small; lower jaw slightly shorter. Maxillary well exposed, about to eye. Teeth brush-like, in bands in jaws. Interorbital slightly convex. Lower preopercle edge serrate. Rakers, 5+11 short weak points, about one-fifth of filaments and latter 2 in eye. Scales all narrowly exposed, small ones extending over vertical fins basally and breast. Cheek with 8 rows of scales to preopercle corner. Ventral axil with free pointed scaly flap about half ventral spine. Suprascapula entire. Scales with fine complete circuli, and 3 basal radii convergent. Lateral line steeply arched, and simple tubes well exposed. Fourth erect dorsal spine longest,

1⅔ in head, ninth ray nearly 1. Second anal spine, 2½ in head; first ray about 1½. Caudal with median rays longest, slightly larger than head; ventral spine, 1½, and first ray with filamentous end to second anal ray base. Long falcate pectoral reaches caudal base. Color in alcohol largely pale brownish; head and trunk everywhere tinged with silvery-white. Iris whitish. Length, 140 mm.

No. 12229, A. N. S. P., type of *Cryptosmilia luna* Cope. S.

Although described as "everywhere uniform silvery" by Cope, very slight indications of the darker transverse or vertical bands, somewhat as figured by Pellegrin in his var. *africana*,[1] are evident. This last was originally described by Osorio and appears in no way to differ structurally from the above. Further comparison with Philippine material, but slightly smaller, shows only a slight difference in scale structure or with usually 5 or 6 basal radii, while the Liberian example has but 3 or 4 and usually 3.

PSETTUS SEBAE Cuvier.

One example. G.

MAPO SOPORATOR (Valenciennes).

One 85 mm. C. C.

PERIOPHTHALMUS BARBARUS (Linnaeus).

Two small ones. G.

PSETTODES ERUMEI (Schneider).

Head, 3¾; depth, 2⅔; D. 54; A. 40; scales, 70 in lateral line to caudal base and 6 more on latter; 21 scales above lateral line, 27 below; snout, 3½ in head from upper jaw tip; eye, 6¾; maxillary, 1½; interorbital, 2⅕ in snout. Contour uniform ellipsoid. Caudal peduncle well compressed; length, three-fourths its least depth or latter 2⅝ in total head length. Head width, 2⅔ its length. Snout conic, broad as long. Upper eye advanced for first third beyond lower. Mouth large, lower jaw well protruded. Maxillary long, extends well beyond eye or about three-fifths in head; expansion 1⅛ in eye. Teeth long, slenderly conic, in two rows with inner depressible inward, and all of larger barbed. Interorbital level. Rakers, 14+20 short spinescent rudiments; filaments, 1⅓ in eye. Scales large, mostly cycloid; some very weakly and sparsely ctenoid on left or colored side. Smaller scales along body edges, and caudal very finely scaled. About 8 rows of scales on cheek; maxillary also scaly. Scales of colored side with 40 radiating basal striae; same number but marginal on pale side and very fine circuli incomplete. Lateral line midway along side, inconspicuous. Dorsal origin eye-diameter behind lower eye, twenty-third ray, 2$\frac{9}{10}$ in head; thirteenth anal ray, 2⅘. Caudal

[1] Annals L'Inst. Oceanogr., Prince de Monaco, vol. 6, fasc. 4, 1914, p. 57, fig. 58, fig. 9.

double convex behind; median rays longest or $1\frac{1}{4}$ in head; pectoral, 2; ventral left, $2\frac{3}{4}$. Color in alcohol dull brownish on left side, with many well scattered pale spots, none larger than scale exposure. Right side uniform white. Length, 395 mm. S.

A smaller example, 171 mm. long, from Sumatra, differs in the scales having 18 to 20 basal striae, a condition doubtless due to age. Its left or colored side is quite dark, also fins, and without any pale spots.

CYNOGLOSSUS GOREENSIS Steindachner.

Head, $5\frac{2}{3}$; depth, $3\frac{3}{4}$; D. 123; A. 94; scales, 30 + 94 in median lateral line to caudal base; 15 scales above median lateral line at widest part of body to upper lateral line, 24 below at same point; snout, $2\frac{2}{3}$ to lower eye; mouth cleft, 4. Contour evenly elongately ellipsoid. Head width, $4\frac{3}{4}$ its length. Snout broadly depressed; profile nearly complete semicircle. Eye small, about half of interorbital, and upper half advanced before lower. Lower nostril close before upper eye along mouth edge or about midway in mouth cleft. Upper nostril midway between eyes. Mouth cleft on blind side more curved than on colored side. Lips entire. Interorbital very slightly depressed. Scales largest over median portion of trunk, become small and crowded about borders, strongly ctenoid on left or colored side and cycloid on right or blind side; basal striae about 40 to 44 and circuli only complete apically on blind side. Two lateral lines, upper 8 scales from dorsal body edge. Caudal pointed, $1\frac{5}{6}$ in head. Color in alcohol pale uniform brownish on left or colored side; right side whitish. Length, 327 mm. S.

6. ASHANTEE.

The fishes from this country were all obtained by the Eclipse Expedition in the Beyah River at Elmina, or the vicinity of the latter. Though a number of scattered references to the fishes of the Gold Coast occur, the only work of primary faunal interest is Bleeker's celebrated "Memoire sur les Poissons de la côte de Guineé."[1] Günther described a few species in his paper on "New fishes from the Gaboon and Gold Coast."[2] Sauvage[3] and Pellegrin[4] have both published papers on the fishes of the adjacent Ivory Coast, useful in this connection.

SCOLIODON EUMECES (Pietschmann).

Body compressed, depth $8\frac{2}{3}$ to $9\frac{1}{2}$ to last caudal vertebra. Head depressed, $4\frac{1}{2}$ to $5\frac{1}{8}$ in body; width $1\frac{2}{3}$ to $1\frac{3}{4}$ its length. Snout greatly depressed, long, end blunt, 2 to $2\frac{1}{10}$ in head. Eye about eye-diameter

[1] Nat. Verhandel. Holl. Maats. Wet. Haarlem, vol. 18, 1863, No. 2, pp. 1–136, pls. 1–28.
[2] Ann. Mag. Nat. London, ser. 3, vol. 20, 1867, pp. 110–117.
[3] Bull. Soc. Zool. France, 1882, pp. 313–325, pl. 5, fig. 1.
[4] Idem, vol. 38, 1913, pp. 151–158.

nearer gill-opening than snout tip, 3¾ to 4½ in snout. Nictitating membrane below eye forward. Mouth greatly arched, wider than cleft. Upper labial fold little longer, about fourth of upper jaw. Teeth alike, 24 or 23 below, 25 above, edges entire, bases wide. At front of upper 1 or 2 erect teeth and 2 or 3 in front of lower. Interorbital broadly convex, 2⅙ to 2¼ in head. Gill-openings about wide as eye. Scales with 3 ribs ending in as many points and median longest. First dorsal origin opposite end of inner pectoral angle, extended end behind reaching opposite ventral origin. Second dorsal base about 1½ of anal base and one-third above end of anal base. Second dorsal end behind 1½ to 1¾ lengths from its base behind to caudal pit above, which larger. Tail 3½ in entire length. Pectoral, 1⅔ to 1⅘ in head; ventral, 3. Color in alcohol ash-gray generally, below whitish. Iris pale. Fins all ash-gray; hind edges of lower, including lower caudal lobe whitish, or at least paler. Border of long caudal lobe narrowly brownish. Length 310 to 314 mm., two examples.

Allied with *Scoliodon laluudi* (Müller and Henle) from the tropical Atlantic of Central and South America. Compared with an example of the American species, 425 mm. long, from Colon, the lower caudal lobe in blackish marginally, front half of pectoral entirely blackish and inner half only pale, and rictal grooves equal. Although Pietschmann describes the rictal grooves they are not indicated in his lower view of the head.

TORPEDO NARKE (Risso).

Disk partly circular, width greater than length for space about equal to space between front disk edge and spiracle. Snout short, slightly concave medially. Mouth small, slightly crescentic, with longitudinal fold at each angle. Teeth small, about 34 rows above and below. Spiracle twice size of eye, with 7 weak papillae. Eye small, 4 in interorbital. Second dorsal about seven-eighths of first, latter with front half above ventral bases. Second dorsal base more than interdorsal space. Tail short, slightly over one-third of total length. Upper caudal lobe slightly longer. Color in alcohol russet-brown above, with scattered variable small white spots or dots, none larger than pupil. White below, outer pectoral and ventral portions broadly brownish submarginally. Length, 367 mm.

Compared with Italian examples the present one differs in coloration, or the presence of the minute whitish spots and the absence of the five large black ocelli. Compared with *Torpedo torpedo* (Linnaeus) from Italy, the spiracle fringes are found well developed in the latter, besides the presence of usually five to seven dark blue-black ocelli.

Although much confusion has arisen from the composite account of *Raja torpedo* Linnaeus it appears the action of Brünnich[1] clearly indicates the first restriction of the species with the later *Raja marmorata* Risso. Brünnich says: "Dorsum fusco-sanguinolentum, maculis sparsis obscurioribus varium * * * Spiracula 5, subtus utrinque ad pectus." He then mentions a new variety, unknown to himself, however, but described by Salviani with five black oc lli arranged in the form of a pentagon.

MUGIL CEPHALUS Linnaeus.

Head, $3\frac{1}{3}$ to $3\frac{3}{5}$; depth, 4 to $4\frac{1}{8}$; D. IV—I, 8; A. III, 8; scales, 36 to 43 from shoulder to caudal base, and 4 to 6 larger out over latter; 12 or 13 scales transversely between soft dorsal and anal origins; 23 to 27 predorsal scales; snout, 4 to $4\frac{1}{2}$ in head; eye, $3\frac{3}{4}$ to 4; maxillary, $3\frac{3}{4}$ to $4\frac{1}{5}$; interorbital, $2\frac{3}{4}$ to 3. Rakers, 30+32, $2\frac{1}{2}$ in filaments and latter $\frac{7}{8}$ of eye. Length, 95 to 139 mm.; four examples.

Compared with an Italian example, with 41 scales from shoulder to caudal base, the rakers were 33+46. The adipose eyelid much better developed in the Italian fish, though scarcely as much so as in adults from Italy and the Mediterranean. The scales of Italian examples show basal radii 8 to 10, those from Ashantee 7 to 9, doubtless a condition of age.

LIZA RAMADA (Risso).

Head, 3 to $3\frac{2}{5}$; depth, $3\frac{1}{5}$ to $3\frac{1}{2}$; D. IV—I, 8; A. III, 9; scales, 37 to 39(?) from shoulder to caudal base, and 5 or 6 larger out over latter; 12 or 13 scales transversely at soft dorsal and anal origins; 25 to 28 predorsal scales; snout, $3\frac{3}{4}$ to 5 in head; eye, $3\frac{1}{4}$ to 4; maxillary, $3\frac{1}{2}$ to $3\frac{4}{5}$; interorbital, $2\frac{1}{2}$ to $2\frac{7}{8}$; rakers, 35+48. Length, 56 to 85 mm.; four examples.

Though I only have young African examples, doubtless of this species, considerable variation due to age was noted when compared with Mediterranean examples. The latter, 155 mm. long, had 44 to 47+50 to 75 rakers. The African examples show 9 to 11 basal radii and no apical denticles on the scales, while in 8 large Mediterranean examples these variations are covered.

LIZA FALCIPINNIS (Valenciennes).

Head, $3\frac{2}{5}$ to $3\frac{3}{4}$; depth, $3\frac{2}{5}$ to $3\frac{3}{4}$; D. IV—I, 9; A. III, 11; scales, 35 to 39 from shoulder to caudal base and 4 or 5 larger out over latter; 12 or 13 scales transversely between soft dorsal and anal origins; 29 to 31 predorsal scales; snout, $3\frac{7}{8}$ to 4 in head; eye, $3\frac{7}{8}$ to $4\frac{1}{8}$; maxillary, $3\frac{4}{5}$ to 4; interorbital, $2\frac{2}{3}$ to 3. Elongate, well compressed, deepest at anal origin. Caudal peduncle well compressed, long as

[1] Ich. Massiliens., 1768, p. 1.

deep and least depth 2¼ to 2⅓ in head. Head width, 1¾ its length. Snout broad, length half its width. Eye advanced; hind edge slightly before center in head length. Mouth broad. Teeth extremely minute, rudimentary, few, in single row and only in upper jaw. Maxillary concealed, not quite to eye. Upper lip width nearly half of pupil. Nostrils close; front one about midway in snout. Interorbital broadly convex. Preorbital denticulate. Rakers, about 40+51, finely lanceolate, about half of filaments and latter equal eye. Scales with 7 to 9 basal striae. Cheek with 3 rows of scales. Pectoral without axillary scaly flap, and 4 scales behind depressed spinous dorsal tip and soft dorsal origin. Spinous dorsal inserted midway between eye center and caudal base, or midway between front eye edge and caudal base in small examples; second spine slightly longer, or 1⅞ to 2⅛ in head. Soft dorsal inserted much nearer spinous dorsal origin than caudal base, first branched ray, 1⅗ in head. Anal inserted about midway between ventral origin and caudal base, 1⅔ to 1⅗ in head. Caudal large, pupil length in smallest example to eye-diameter longer than head in larger ones; pectoral, 1¼; ventral, 1½. Color in alcohol, dull olive-brown above; sides and below, paler with silvery-white reflections. Iris whitish. Fins all pale brownish, with obsolete brownish blotch at pectoral base. Eight examples, 105 to 145 mm.

Boulenger's figure [1] does not indicate any scales on the opercle; those on the cheek imperfect and front of soft dorsal and anal basally scaleless. In all my examples these areas are quite scaly.

An Angola example in the Academy (Bengo River at Cabiri) shows: head, 3⅔; depth, 3⅔; D. IV—I, 9; A. III, 11; scales, 39 from shoulder to caudal base and 6 more on latter; transverse scales, 13; predorsal, 23; snout, 4 in head; eye, 3⅔; maxillary, 4; interorbital 2⅗; few scales on front of anal basally; length, 82 mm.

LIZA HOEFLERI (Steindachner).

Head, 3⅘; depth, 4⅕; D. IV—I, 8; A. III, 9; scales, 36 from shoulder to caudal base and 5 more on latter; 13 scales transversely between soft dorsal and anal origins; 25 predorsal (pockets) scales; snout, 4⅕ in head; eye, 3⅗; maxillary, 4; interorbital, 3. Elongate, rather slender, or deepest at spinous dorsal origin, well compressed. Caudal peduncle with least depth, 1⅓ its length, or 2¼ in head. Head width half its length. Snout length nearly three-fifths its width. Eye advanced; hind edge about midway in head length. Mouth broad; would form obtuse angle. Row of minute ciliate teeth in upper jaw. Maxillary exposed, almost to eye. Nostrils close together, front one about midway in snout length. Interorbital broadly convex. Preorbital denticulate. Rakers, 35+46, about

[1] Cat. Fresh Water Fish. Africa, vol. 4, 1916, p. 89, fig. 51.

three-fourths of filaments, or 1¼ in eye. Scales with 9 or 10 basal radii. Cheek with three rows of scales. Apparently no axillary ventral flap, and three scales between depressed spinous dorsal tip and soft dorsal origin. A few scales on front of anal basally. Spinous dorsal inserted about midway between front pupil edge and caudal base; first spine longest, or 1⅘ in head. Soft dorsal inserted very slightly nearer caudal base than spinous dorsal origin; first branched ray, 1⅘ in head. Anal inserted slightly before soft dorsal; first branched ray, 1⅗ in head. Caudal about equals head; pectoral, 1⅙; ventral, 1⅗. Color in alcohol with back, pale olive; sides and below pale with silvery-white tints. Hind edge of median caudal rays tinged with dusky; fins otherwise dull brownish and lower ones paler. Iris, whitish. Length, 105 mm.

It differs a little from Boulenger's account, likely due to age, in the snout slightly shorter than the eye. Compared with Mediterranean examples of *Liza aurata* (Risso) it agrees in the long pectoral and serrate preorbital, though the rakers are 35+46, in the adults 40+70, which shorter and though finely lanceolate, about three-fourths in young to two-thirds in adults in filaments. The Mediterranean species has scales with more obtuse apical denticles, lower or slightly less concealed. Both have 9 or 10 basal radii, reaching 12 or 13 in the Mediterranean, and always with very fine circuli.

LIZA GRANDISQUAMIS (Valenciennes).

Head, 3⅖ to 3¾; depth, 3¾ to 3⅘; D. IV—I, 8; A. III, 9; scales, 28 or 29 from shoulder to caudal base and 5 or 6 larger on latter; 10 scales transversely between soft dorsal and anal origins; 20 to 23 predorsal scales; snout, 3⅞ to 4½ in head; eye, 4 to 4⅗; maxillary, 3⅞ to 4; interorbital, 2½ to 2⅞. Elongate, well compressed, deepest at anal origin. Caudal peduncle well compressed; least depth, 1 to 1⅛ its length or 2⅕ in head. Head width, 1⅗ to 1⅔ its length. Snout broad; length about half its width. Eye advanced, before center in head length. Mouth broad. Teeth extremely minute, rudimentary, few above laterally, slightly more developed in smaller example. Maxillary end exposed little; reaches eye. Nostrils close, front one about midway in snout length. Interorbital broadly convex. Preorbital conspicuously denticulate. Rakers, 34+42, finely lanceolate, about two-thirds gill-filaments and latter 1⅙ in eye. Scales with 8 to 11 basal striae. Cheek with four rows of scales. Ventral without axillary scaly flap and two scales between depressed spinous dorsal tip and soft dorsal origin. Small scales over base of front anal lobe and along front edge of soft dorsal. Spinous dorsal inserted about midway between front pupil edge and caudal base, midway between hind pupil edge and caudal base in smaller example; first spine, 1⅔ in head. Soft dorsal inserted midway between spinous

dorsal origin and caudal base; first branched ray 1⅓ in head, reaching caudal base in smaller example. Anal inserted about midway between ventral origin and caudal base, nearer latter in smaller example; 1¼ to 1⅔ in head. Caudal large; eye-diameter longer than head, deeply forked, with lower lobe much longer in larger example; pectoral, 1¼ to 1½; ventral, 1⅔. Color in alcohol dull olive-brown above, paler to whitish below. Fins all pale brown. Two examples, 110 to 146 mm.

CARANX HIPPOS (Linnaeus).

Head, 2⅞ to 3¼; depth, 2⅛ to 2⅔; D. VIII—I, 19 to 22; A. II—I, 15 to 18; scutes in lateral line, 29 to 36; snout, 3⅔ to 4 in head measured from upper jaw tip; eye, 3 to 3⅔; maxillary, 2¼ to 2⅙; interorbital, 3 to 3⅛; rakers, 6+15 or 16. Five examples, 50 to 104 mm.

An examination and comparison with American examples from Brazil, Santo Domingo, and New Jersey reveals no distinctions. The cycloid scales of all are with similar circuli and no basal striae.

EPINEPHELUS AENEUS (Geoffroy St. Hilaire).

Head, 2⅔; depth, 3⅛ to 3⅓; D. X or XI, 15; A. III, 8; scales about 102 to 108 along and close above lateral line to caudal base and 15 to 18 more on latter; tubes, 71 to 73 in lateral line to caudal base and 13 to 20 on latter; 14 or 15 scales above lateral line to soft dorsal origin, 28 to 34 below; snout, 4 to 4⅔ in head from upper jaw tip; eye, 4; maxillary, 2 to 2⅛; interorbital, 7 to 7¼. Well compressed, back but little elevated. Caudal peduncle, length about ⅘ to ⅞ its least depth; latter 3⅓ to 3½ in total head length. Head width, 2⅔ its length. Snout conic; length three-fourths its width. Eye advanced little beyond middle in head length; less so with age, and impinging on upper profile. Mouth large; lower jaw well protruded. Maxillary to or slightly beyond pupil, not quite to hind eye edge; expansion 1⅞ to 2 in eye. Teeth in rather narrow bands. Two rows below in sides of mandible. Canines moderate, distinct pair in front above and another depressible inner pair. Moderate teeth in bands on vomer and palatines, in about three rows on latter. Interorbital slightly convex, with little median depression. Hind preopercle edge serrate, with cluster of four enlarged divergent spines at angle. Rakers VI, 2+8 to 11 V or VI, lanceolate, about ⅞ of filaments and latter about 2 in eye. Pseudobranchiae equal gill-filaments. Muzzle and maxillary naked. Scales on head small and cycloid, with apical circuli coarser than marginal, and 2 or 3 short basal striae. About 22 rows of scales on cheek. Scales on trunk small, crowded or smaller along edges and over fin bases, mostly cycloid, circuli mostly even and with 4 or 5 basal radii. Only few scales along lower sides ctenoid, or with about 5 minute apical denticles. Tubes in

lateral line simple. Spinous dorsal begins over pectoral origin; third spine longest, or $2\frac{2}{3}$ to $2\frac{4}{5}$ in head. Soft dorsal origin midway between spinous dorsal origin and caudal base; fin rounded; fifth ray 2 to $2\frac{1}{5}$ in head. Spinous anal inserted about opposite last dorsal spine base; second anal spine longest, little longer than third, or $2\frac{7}{8}$ to $3\frac{2}{5}$ in head. Caudal rounded, $1\frac{1}{3}$ to $1\frac{1}{2}$ in head; pectoral, $1\frac{2}{3}$ to $1\frac{3}{4}$; ventral, $1\frac{5}{6}$ to $1\frac{7}{8}$, spine, $1\frac{2}{3}$ to 2 in fin.

Color in alcohol generally brown, under surface whitish, with five close-set pairs of slightly deeper brown cross-bands, mottled obscurely and sparsely with still deeper brown. Head with three pale lines, uppermost from hind eye edge to pectoral origin, median from lower hind eye edge toward lower pectoral basal edge, and lowest line from lower preorbital edge to breast. Fins pale brown; edges of dorsals deep brown, and median deep brown longitudinal band whole length of fin, though broken behind on soft fin as several blotches. Dark crossbars on trunk extend on dorsal bases as blotches. Anal with lower edge whitish and two pale brown longitudinal lines obliquely up behind. Caudal with several indistinct brown crossbars. Pectoral very pale. Ventral brown, front terminal edge whitish, and otherwise dusky terminally. Iris pale brown. Three examples. 89 to 95 mm.

LUTJANUS GUINEENSIS Bleeker.

Head, $2\frac{1}{3}$ to $2\frac{2}{3}$; depth, $2\frac{2}{3}$; D. X, 14; A. III, 8; scales 44 to 49 in lateral line to caudal base and 5 or 6 more on latter; 7 scales above lateral line to soft dorsal origin, 12 or 13 below; 12 to 16 predorsal scales; snout, $2\frac{9}{10}$ to $3\frac{2}{5}$ in head; eye, $3\frac{1}{3}$ to 4; maxillary, $2\frac{3}{5}$ to $2\frac{2}{3}$; interorbital, 5 to $5\frac{3}{4}$. Well compressed, back elevated. Cauda peduncle well compressed; least depth $\frac{3}{4}$ to $\frac{4}{5}$ its length. Head compressed, pointed, profiles straight and even, width $2\frac{2}{5}$ to $2\frac{1}{2}$ its length. Snout conic; width, $1\frac{1}{5}$ its length. Eye little ellipsoid; hind pupil edge little advanced to center in head length. Maxillary not quite to pupil. Mouth large, jaws even. Bands of villiform teeth in jaws, outer row of enlarged conic teeth and in front of upper pair of canines. Villiform teeth on vomer and palatines, in ↑-shaped patch on former. Tongue free, pointed, with elongate median patch of minute teeth. Front nostril small pore, three-fourths an eye-diameter before eye. Hind nostril twice as large and midway in space to eye. Interorbital broadly convex. Hind preopercle edge straight, finely serrate, with serrae little enlarged at angle, nine on lower edge forward. Least preorbital width about one-third to four-fifths of eye. Rakers, v I+8 IV, lanceolate, two in eye and about long as filaments. Pseudobranchiae equally large as filaments. Scales finely ctenoid, with radiating basal striae about 21. Above lateral line scales at first parallel, then rather abruptly oblique after

front part of spinous dorsal, though parallel on caudal peduncle above. Scales below lateral line in horizontal rows. Small scales on breast, much more so on vertical fin bases. Cheek with 7 rows of scales. Suprascapula denticulate marginally. Lateral line concurrent with dorsal profile; tubes inconspicuous. Spinous dorsal begins about over pectoral origin, fourth spine $2\frac{1}{3}$ to $2\frac{3}{4}$ in head. Soft dorsal inserted little nearer caudal base than spinous dorsal origin; fin rounded. Spinous anal begins little behind soft dorsal origin: second spine longest or $2\frac{2}{5}$ to $2\frac{5}{6}$ in head. Soft anal rounded: third ray $1\frac{3}{4}$ to $2\frac{1}{3}$ in head. Caudal with hind edge slightly emarginate. Pectoral, $1\frac{1}{3}$ to $1\frac{3}{5}$ in head; ventral, $1\frac{1}{3}$ to $1\frac{2}{3}$; and spine about half of fin; filamentous end of first ray nearly to vent; last slightly less than an eye-diameter before anal.

Color in alcohol brown on back and above; below paler to whitish. Each scale below lateral line with pale yellowish spot formed into lengthwise streaks. Below front nostril close to preorbital edge a bluish line, with narrow dark brown bordering lines, extending along lower eye edge back to hind preopercle angle. Iris pale yellowish. Fins brownish, ventral and anal whitish. Pectoral base brown. Three examples, 46 to 190 mm.

Bleeker shows [1] the hind preopercle edge with a slight gash above its corner, hardly evident in my examples.

LUTJANUS MODESTUS Bleeker.

Head, $2\frac{2}{5}$ to $2\frac{3}{4}$; depth, $2\frac{2}{3}$ to $2\frac{7}{8}$; D. X, 13 or 14; A. III, 8; scales, 45 in lateral line to caudal base and 6 more on latter; 6 scales above lateral line to soft dorsal origin and 12 below; 14 or 15 predorsal scales; snout, $3\frac{1}{6}$ to $3\frac{1}{3}$ in head from upper jaw tip; eye, $3\frac{2}{3}$ to $4\frac{1}{3}$; maxillary, $2\frac{1}{3}$ to $2\frac{2}{5}$; interorbital, 5 to $5\frac{1}{4}$. Well compressed, back little elevated. Caudal peduncle well compressed, about long as deep. Head pointed, sides flattened; width, $2\frac{3}{4}$ its length. Snout conic, long as wide, or width $1\frac{1}{8}$ its length. Eye slightly ellipsoid; hind edge midway in its length, little backward in young. Maxillary beyond front of pupil or about two-fifths in eye. Mouth large, lower jaw slightly protruding. Bands of villiform teeth in jaws. outer row of enlarged conic canines; canines each side of lower jaw and pair in front of upper. Bands of villiform teeth on vomer and palatines, in $\wedge$-shaped patch on former. Tongue free, pointed, with elongate median area of minute teeth. Front nostril small pore advanced before eye three-fifths an eye-diameter, and hind nostril little larger midway between front one and eye. Interorbital broad, very slightly convex. Hind preopercle edge finely serrate, serrae little enlarged at angle, and with none on lower edge forward, though slight emargination just above corner. Least preorbital width about one-

[1] Nat. Verhandel. Holl. Maats. Wet. Haarlem, vol. 18 (P. Guinée), 1863, p. 46, pl. 10, fig. 1. Ashantee.

third to three-fifths of eye. Rakers, v, I+7 or 8, iv, lanceolate, about seven-eighths of filaments; latter $1\frac{3}{5}$ in eye. Pseudobranchiae nearly large as eye. Scales finely ctenoid, with about 20 basal striae. Scales above lateral line parallel, below in horizontal rows. Small scales on breast, more so on vertical fin bases. Cheek with 7 rows of scales. Suprascapula denticulate marginally. Lateral line concurrent with back, tubes inconspicuous. Spinous dorsal begins about over pectoral origin; fourth spine $2\frac{5}{8}$ in head. Soft dorsal inserted about midway between spinous dorsal origin and caudal base; eighth ray, $2\frac{2}{3}$ to 3 in head. Anal inserted slightly behind soft dorsal origin; second spine longest, or 3 to $3\frac{1}{4}$ in head. Soft anal rounded; third ray longest, or $2\frac{1}{8}$ to $2\frac{1}{6}$ in head. Hind caudal edge slightly emarginate. Pectoral, $1\frac{2}{5}$ to $1\frac{3}{5}$ in head; ventral, $1\frac{1}{2}$ to $1\frac{3}{5}$, but not quite to vent, which little nearer its tip than anal origin. Ventral spine about two-fifths to three-fifths in fin; first ray filamentous.

Color in alcohol brown on back above, paler to whitish below. No yellow spots on scales. From below hind nostril to lower eye edge narrow pale bluish line, bordered above and below with brown and not extended beyond eye. Fins brownish, ventral pale; lower front anal edge whitish and soft dorsal with two irregular rows of darker brown spots on membranes below middle. Iris pale. Two examples, 63 to 172 mm.

Bleeker's figure shows [1] the scales above and below the lateral line in irregular rows, the maxillary nearly to eye center, no pale line below eye, and scales in lateral line branched.

POMADASIS JUBELINI (Cuvier).

Three examples, 103 to 175 mm.

POMADASIS BENNETTII (Lowe).

One example (see page 283).

EUCINOSTOMUS MELANOPTERUS (Bleeker).

Head $2\frac{3}{5}$ to $3\frac{1}{5}$; depth, $2\frac{5}{6}$ to $3\frac{1}{4}$; D. IX, 10; A. III, 7; scales (pockets), 40 to 42 in lateral line to caudal base and 4 to 7 more on latter; 4 or 5 scales above lateral line, 8 or 9 below; snout, 3 to $3\frac{1}{4}$ in head from upper jaw tip; eye, $2\frac{3}{4}$ to $3\frac{1}{5}$; maxillary, $2\frac{3}{4}$ to 3; interorbital, $3\frac{1}{4}$ to $3\frac{2}{5}$. Form elongate, rather fusiform, compressed. Caudal peduncle compressed; least depth, $\frac{2}{3}$ to 1 in length. Head large, pointed, compressed; flat sides very slightly converge below; width, $2\frac{1}{8}$ to $2\frac{1}{3}$ in head. Snout conic, long as wide. Eye large, advanced, hind pupil edge but very slightly behind center in head

[1] Nat. Verhandel. Holl. Maats. Wet. Haarlem, vol. 18 (P. Guinée), 1863, p. 50, pl. 9, fig. 2. Ashantee.

length. Maxillary beyond front eye edge, not to pupil. Lips rather broad, firm. Teeth fine, in villiform bands in jaws. Nostrils together, close before upper front of eye. Interorbital level or only very slight median concavity. Preorbital and preopercle edges entire. Rakers, 5 or 6 + 8 or 9 short points, nearly one-third of filaments; latter $2\frac{1}{2}$ in eye. Pseudobranchiae little less than filaments. Premaxillary groove on top of head entirely scaleless, also maxillary, preorbital and snout tip. Hind part of premaxillary groove never entirely shut off by lateral intrusion of scales. Scales finely ciliated, with about five basal striae. Suprascapula entire. Lateral line concurrent with back to caudal base medially; simple tubes well exposed. Spinous dorsal inserted nearly midway between eye center and soft dorsal origin; slightly more advanced in young; third spine, $1\frac{4}{5}$ to $1\frac{9}{10}$ in head. Anal inserted little behind soft dorsal origin; third spine longest or trifle longer than second; $2\frac{3}{4}$ to $2\frac{4}{5}$ in head. Caudal well forked, trifle less than head; pectoral, $1\frac{1}{10}$ to $1\frac{3}{8}$; ventral, $1\frac{3}{5}$ to $1\frac{3}{4}$. Color in alcohol silvery-white generally; back pale brownish. Iris white. Fins all very pale brown; end of spinous dorsal lobe black with white bar below, and midway on fin still lower pale dusky horizontal streak. Seven examples, 47 to 108 mm.

Bleeker does not show [1] the whitish band below the black apical blotch at front of spinous dorsal, nor mention it in his text. His example was 97 mm. long.

GALEOIDES DECADACTYLUS (Bloch).

Two examples.

TILAPIA HEUDELOTI A. Dumeril.

Thirty-seven examples.

CHAETODON HOEFLERI Steindachner.

Head, $2\frac{1}{2}$ to $2\frac{3}{4}$; depth, $1\frac{2}{5}$ to $1\frac{3}{5}$; D. XI, 23; A. III, 18; scales, 43 to 45 from shoulder in nearly median series to caudal base medially; about 40 or 41 tubes in lateral line; 7 scales above lateral line to spinous dorsal origin, about 4 to soft dorsal origin, and 22 or 23 below to spinous anal origin; snout, 3 to $3\frac{2}{3}$ in head; eye, $2\frac{3}{4}$ to 3; maxillary, $3\frac{2}{3}$ to $3\frac{7}{8}$; interorbital, $3\frac{2}{3}$ to $3\frac{1}{4}$. Back well elevated; body strongly compressed; predorsal slightly trenchant. Caudal peduncle strongly compressed; length about three-fifths its least depth and latter, $2\frac{7}{8}$ in head. Head width half its length. Snout conic, length about seven-eighths its width. Eye elevated, advanced, or hind pupil edge about midway in head length. Small mouth terminal, closed jaws even. Maxillary largely below preorbital, to hind nostril and expansion $1\frac{2}{3}$ in horizontal pupil. Teeth in brush-like bands. Lips rather thin, moderate. Nostrils close before eye

[1] Nat. Verhandel. Holl. Maats. Wet. Haarlem, vol. 18 (P. Guinée), 1863, p. 44, pl. 8, fig. 1. Guinea.

above, front one little lower or about three-fifths of pupil length before eye. Interorbital broadly convex. Rakers, 3 + 9 or 10 weak points, about 4 in filaments and latter $1\frac{2}{3}$ in eye. Scales ctenoid, with about 14 basal striae, in oblique rows above and below lateral line, become much smaller and greatly crowded over rayed vertical fins. Cheeks with five rows of scales. Lateral line greatly arched; ends close below last dorsal rays. Dorsal with stronger and slightly longer spines in front; fifth spine, $1\frac{1}{2}$ to $1\frac{4}{5}$ in head; fin edge notched. Soft dorsal rounded, fifth ray $1\frac{5}{6}$ to 2 in head. Spinous anal inserted about midway between hind preopercle edge and caudal base; second spine 2 in head, and fifth ray about $1\frac{3}{4}$ to 2. Caudal convex behind, $1\frac{2}{3}$ to $1\frac{1}{2}$ in head; pectoral, $1\frac{1}{4}$; ventral spine, $1\frac{3}{4}$ to $1\frac{7}{8}$.

Color in alcohol pale brownish generally, lower or under surfaces pale or whitish. Deep brown broad band begins just below and before spinous dorsal origin, but not meeting its fellow on predorsal, extends forward to eye, which it intersects, leaving hind portion of iris whitish. This also continued below over cheek to front branchiostegals. Second broad band begins on spinous dorsal, including third to fifth spines, extends down, including pectoral base, hind edge of opercle broadly to ventral base, though about half its width before these fins so its fellow converges. Third broad band extends from last two dorsal spines basally and front dorsal rays basally, down toward front of soft anal, narrowed and paler below, but quite dark and conspicuous at its origin above. Dark transverse band across caudal peduncle, followed by narrow white border. All dark bands noted with rather narrow pale borders. Edges of soft dorsal and anal dusky. Fins all pale, and caudal base with dull brownish crescent transversely. Each scale on breast and along side of abdomen between dark bands with small pale spot. Two examples, 63 to 66 mm.

Compared with examples of *Chaetodon striatus* (Linnaeus) from Delaware Bay and the West Indies, 68 to 136 mm. long, one finds a constant difference in coloration. In *C. hoefleri* the second broad dark band extends more obliquely forward to include hind portion of opercle entirely, besides pectoral and ventral bases likewise; third band deeply black above and not joined by dark band on basal portion of soft dorsal. Due to youth, likely, my examples of *C. hoefleri* differ somewhat from Steindachner's figure, as dark edges on soft dorsal and anal are broader; second dark band extends more forward to include more of opercle besides ventral base and area well before it.

HAPATUS HEPATUS (Linnaeus).

Head, $3\frac{1}{8}$; depth, $1\frac{3}{4}$; D. IX, 26; A. III, 24; snout, $1\frac{4}{5}$ in head; eye, 3; maxillary, 4; interorbital, $3\frac{1}{3}$; caudal spine about 2 in eye. Caudal slightly lunate, truncate when expanded. Color in alcohol

largely uniform brownish, dorsals, anals, ventrals, and median caudal rays terminally dusky to blackish-brown, though hind caudal edge narrowly whitish. Pectoral pale brown. Iris whitish. Length, 77 mm.

Agrees with examples from Colon, Panama, upon comparison.

MAPO SOPORATOR (Valenciennes).

Five examples.

PERIOPHTHALMUS BARBARUS (Linnaeus).

Twelve examples, 56 to 173 mm. Adults usually with trunk of uniform color, young with 5 or 6 dark brown blotches along side, and caudal with about 9 narrow dark brown crossbars. In adults lower caudal edge variously broadly white, also upper edge occasionally whitish.

CITHARICHTHYS SPILOPTERUS Günther.

Three small examples, 65 to 72 mm.

7. KAMERUN.

A small collection of fishes made by the Rev. R. H. Nassau, at Great Batanga, and sent to Princeton University, has been studied in this connection. The collection is now in the museum of Princeton University, and to the officers of the same I am indebted for the opportunity of its examination. A list of the fishes was recently given over my name.[1] The first account of the Kamerun fishes is Peters list of the Bucholz collection,[2] though he describes the interesting *Pantodon* about the same time.[3] Since then the only accounts are by Ehrenbaum[4] and Pietschmann,[5] who note but few species.

GALEICHTHYS LATISCUTATUS (Günther).

Head $3\frac{2}{5}$; depth, $4\frac{3}{4}$; D. I, 7; A. IV, 14; snout, $2\frac{3}{5}$ in head measured from upper jaw tip; eye, $6\frac{2}{3}$; mouth width, $2\frac{1}{4}$; interorbital, $2\frac{1}{5}$; first branched dorsal ray, $1\frac{1}{3}$; least depth of caudal peduncle, 4; lower caudal lobe, $1\frac{2}{5}$; pectoral, $1\frac{1}{3}$; ventral, $1\frac{1}{2}$.

Body compressed, flattened below in front. Caudal peduncle compressed. Head wide, depressed, upper profile evenly though slightly convex. Snout broad, length $1\frac{3}{4}$ its width. Eye moderate, advanced, hind edge midway in head length. Mouth broad, slightly inferior. Teeth in wide bands in jaws, fine, ends of bands rounded. Palatine teeth in two large patches, fine, and each patch of rounded design. Maxillary barbel nearly to end of pectoral ray; outer mental to pectoral ray base and inner mental $1\frac{1}{2}$ to pectoral base. Nostrils large,

[1] Copeia, No. 45, June 24, 1917, p. 53.
[2] Monatsber. Ak. Wiss. Berlin, 1876, pp. 244–252, pl. 1.
[3] Idem, pp. 195–200
[4] Ueber Fische von Westafrica besonders Kamerun. Fischerboten, vol. 5, 1913, pp. 308, 358, 398, 506.
[5] Jahrb. Nassauisch. Ver. Naturk. (Weisbaden), vol. 66, 1913, pp. 171–187.

close, near snout edge, hind one with well-developed flap, about an eye-diameter directly before eye. Fontanel on head narrow, reaches occipital buckler. Bones of head, occipital buckler, and front of dorsal spine strongly rugose. Rakers about 4+8, lanceolate, little shorter than filaments. Lateral line complete, distinctly arched at first. Opercles moderately striate. Humeral process about long as snout, with few striae. Dorsal origin slightly behind pectoral center. Adipose fin rounded, about long as snout. Caudal well forked, lobes about equal. Anal inserted little nearer caudal base than dorsal origin, front rays little shorter than last. Pectoral reaches seven-eighths to ventral, which inserted midway between caudal base and hind nostril and long fin reaches first fifth of anal.

Color in alcohol brown above, whitish on belly and under surfaces. Dorsal, pectoral, ventral, and anal with dusky on median terminal portions. Maxillary barbel brownish, other barbels pale. Iris brownish. One example, 267 mm.

The above differs from the Sierra Leone specimens in its much longer barbels, depressed dorsal $1\frac{2}{3}$ to adipose fin and longer pectoral, which reaches near ventral.

TYLOSURUS CHORAM (Forskål).

Head (damaged), $3\frac{1}{3}$; depth, $12\frac{1}{2}$ in trunk, excluding head and caudal fin; D. II, 20?; A. II, 20; P. I, 13; scales about 385 to caudal base, counted in median lateral row from gill-opening; 18 scales above lateral line to dorsal origin, 5 below; about 310 predorsal scales; eye, $2\frac{2}{3}$ in postocular; interorbital, $1\frac{7}{8}$.

Body moderately compressed. Caudal peduncle about wide as least depth and keel slightly developed each side. Head convergent below, broad above, width $1\frac{1}{2}$ in postocular region. Eye large, ellipsoid. Jaws long, slender, not completely closing so base of upper leaves a distinct open gape. Teeth of single row enlarged and erect canines in each jaw, and surfaces all about externally with small denticles or asperities. Tongue small, slender, end free. Maxillary largely concealed, reaches first third in eye. Nasal cavity large, longest diameter equals pupil. Interorbital slightly depressed medially. Cheek little wider than opercle. No rakers. Scales small, narrowly imbricated, with basal and apical striae distinct, not convergent or joined over median vertical axis. Head naked, except 22 rows of scales across cheek. Lateral line low, even over caudal base. Dorsal inserted little behind anal origin, lobe about $1\frac{1}{4}$ in postocular space, and hind rays at least twice depth of caudal peduncle, though not longer than median rays. Anal lobe in front like dorsal, equals postocular, other rays lower than dorsal. Caudal damaged, lower lobe evidently longer. Pectoral about equals postocular, ventral $1\frac{1}{4}$.

Color in alcohol dark brown above, paler to whitish below, with silvery reflection. Along side from shoulder to caudal base pale leaden band, below dorsal apparently wide as pupil, but ill defined. Iris pale. Fins brownish; dorsal, pectoral, and caudal darker, and dorsal nearly blackish behind. Length, 545 mm. (beak and caudal damaged).

Compared with an example I identified as *Tylosurus crocodilus* (Le Sueur) from Sumatra,[1] about 622 mm. long, the scale structure is similar, and no specific characters of strong contrast noted. In the Sumatra specimen the scales are larger, about 315 in a lateral series to the caudal base, less narrowly imbricated, and the median and last dorsal rays lower or at least not twice least depth of caudal peduncle. The Sumatra fish has larger predorsal scales, about 290. Peters records *Belone caribaea* Le Sueur from Victoria,[2] which possibly may be the present species. It apparently differs in having 210 predorsal scales

CARANX AFRICANUS Steindachner.

Head, $3\frac{2}{3}$; depth, $2\frac{2}{3}$; D. VIII—1, 21; A. II—1. 18; lateral line of 32 tubes and 44 scutes, curved portion twice that of straight portion; snout, $3\frac{1}{3}$ in head measured from upper jaw tip; eye, $3\frac{1}{3}$; maxillary, $2\frac{2}{5}$; interorbital, $3\frac{1}{3}$; rakers, 12+28, lanceolate. $1\frac{1}{2}$ in eye. Adipose eyelid moderate. Breast naked. Dorsal filament slightly longer than pectoral. Color in alcohol brown above, white below. Outer dorsal and anal membranes of rayed fins brownish, others pale. Length, 254 mm.

VOMER SETAPINNIS (Mitchill).

One example, 220 mm. Depth, 2. Rakers, 6+31.

POMADASIS JUBELINI (Cuvier).

Head, $2\frac{2}{3}$; depth, $2\frac{2}{3}$; D. XI, I, 14; A. III, 9; scales, 51 in lateral line to caudal base and 13 more on latter; 5 scales above lateral line, 12 below; snout, $2\frac{1}{3}$ in head; eye, $4\frac{1}{4}$; maxillary, $3\frac{2}{3}$; interorbital, $4\frac{1}{4}$.

Body compressed, back well arched, and profile evenly convex over ventral base. Caudal peduncle compressed, least depth $3\frac{3}{4}$ in head. Head width $2\frac{1}{4}$ its length. Snout conic, width, $1\frac{1}{3}$ its length. Eye close to upper profile, slightly advanced. Mouth small, nearly horizontal; lower jaw shorter. Maxillary to hind nostril. Lips fleshy. Teeth fine, in bands in jaws; outer upper slightly enlarged; none on vomer. Symphysis with pair of pores and larger median pit little back. Nostrils together; front one large, close to middle of front eye rim. Interorbital slightly convex. Hind preopercle edge undulate, sparsely denticulate and about 5 denticles around corner more prominent. Rakers, 1, 6+13, lanceolate, 3 in eye. Head scaly,

[1] Journ. Acad. Nat. Sci. Phila., ser. 2, vol. 12, 1904, p. 501, pl. 11, upper fig.
[2] Monatsb. Ak. Wiss. Berlin, 1876, p. 250.

except snout, jaws, and chin. About 6 rows of scales on cheek. Scales finely ctenoid, basal striae about 11. Lateral line slightly convex; slopes down till midway at caudal base. Dorsals and anals with developed basal scaly sheaths. Caudal base scaly. Rays of soft dorsal and anal scaleless. Above lateral line scales in oblique rows to front part of spinous dorsal, then parallel with lateral line, and rows below lateral line horizontal. Fourth dorsal spine longest, little less than half of head; fin well separated from soft dorsal; first ray, $2\frac{3}{4}$ in head. Second anal spine much longest, $1\frac{4}{5}$ in head, not quite reaching caudal base; third spine much shorter and more slender, or about long as first ray; both $2\frac{1}{4}$ in head. Caudal with hind edge concave; fin, $1\frac{1}{2}$ in head; pectoral, 1; ventral, $1\frac{1}{2}$.

Color in alcohol brownish, little paler below. Below dorsals on back and sides down to pectoral, with deep brown spots, variable, though largely in horizontal rows, or about four or five rows equally above and below lateral line. Blackish blotch at hind opercle edge little smaller than eye. Outer membranes of spinous dorsal with obscure dusky blotches, and subbasal band of brown spots on membranes of soft dorsal; outer portion of fin brownish. Hind caudal edge tinged with dusky. Length, 230 mm.

The three Ashantee examples listed previously all agree in the characteristic long second anal spine extending beyond any of the anal rays or other spines. They show: head, $2\frac{3}{4}$ to $2\frac{4}{5}$; depth, $2\frac{2}{3}$ to $2\frac{7}{8}$; D. X or XI, 16; A. III, 8 to 10; scales, 46 to 52 in lateral line to caudal base and 8 to 12 more on latter; 5 or 6 scales above lateral line, 11 to 14 below; snout, $3\frac{1}{3}$ in head; eye, $3\frac{2}{5}$ to $3\frac{3}{4}$; maxillary, $3\frac{2}{5}$ to $3\frac{2}{3}$; interorbital, $4\frac{1}{5}$ to $4\frac{1}{3}$; length, 115 to 175 mm.

PSEUDOTOLITHUS TYPUS Bleeker.

Head, $3\frac{1}{3}$; depth, $4\frac{2}{3}$; D. IX, I, 29; A. II, 7; scales 50 in lateral line to caudal base and 22 more on caudal medially; 7 scales above lateral line to soft dorsal and 7 below to anal; snout, $4\frac{1}{2}$ in head, measured from upper jaw tip; eye, $7\frac{2}{3}$; maxillary, $2\frac{1}{3}$; interorbital, $8\frac{1}{5}$.

Body compressed, deepest at pectoral end. Caudal peduncle length about two-thirds least depth; latter $3\frac{4}{5}$ in head. Head width, $2\frac{1}{8}$ its length; upper profile concave to snout. Latter convex; length two-thirds its width. Eye small, faces largely upward; center slightly before first third in head. Mouth large, well inclined; lower jaw well protruded. Maxillary to hind eye edge. Lips thin, fleshy. Teeth fine, in narrow bands and outer row in each enlarged, though upper much larger. In front above one or two slightly enlarged canines. Hind nostril very close before eye and larger than front, which less than half an eye-diameter before front eye edge. Interorbital slightly convex. Preopercle edge obsoletely denticulate.

Suprascapula flexible. Rakers iv 3+13 iv, lanceolate, slightly less than eye. Scales finely ctenoid, with 20 to 24 radiating basal striae, in oblique rows broken by lateral line, and largest scales on costal region. Head, scaly, except muzzle, caudal base scaly. Lateral line complete, mostly concurrent with dorsal profile and midway behind to caudal base. Dorsal origin little behind ventral origin; first spine very short and third spine longest or $2\frac{1}{4}$ in head. Soft dorsal long, uniformly high, first ray, 3 in head. Anal base opposite middle of soft dorsal base, third anal ray, $2\frac{1}{4}$. Caudal pointed medially behind, $1\frac{1}{4}$ in head, pectoral, $1\frac{1}{2}$, ventral, $1\frac{3}{5}$.

Color in alcohol brownish above, whitish below. Fins pale brownish; ventral and anal paler. Dusky shade on opercle. Each row of scales on back and upper surface with slightly darker oblique streaks. Length, 292 mm.

PERIOPHTHALMUS BARBARUS (Linnaeus).

Thirteen examples, 78 to 152 mm.

8. GABUN, FRENCH KONGO.

The first enumeration of Gabun fishes was made by Duméril, in his paper already referred to under the Cape de Verde Islands. Günther describes a number of new species from the Gabun.[1] Sauvage first notes the fishes of the Ogôoue,[2] later elaborated in his "Etude sur la Faune Ichthyologique de l'Ogôoue."[3] and, finally, his "Franciville, Haute Ogôoue."[4] Boulenger describes a new siluroid[5] and a new cichlid.[6] More recently numerous papers by Pellegrin have appeared.[7] The material on which the present account is based is the old collection made by P. B. Du Chaillu received in 1854, and a small lot obtained a few years ago by the late Rev. R. H. Nassau. The Du Chaillu collection is contained in the Academy of Natural Sciences of Philadelphia, while those received from Nassau are in the University of Pennsylvania. The former are indicated by D. and the latter by N.

[1] Ann. Mag. Nat. London, ser. 3, vol. 20, 1867, pp. 110–117; ser. 6, vol. 18, 1896, pp. 262–263.
[2] Bull. Soc. Philom. Paris (7) vol. 3, 1879, pp. 90–103.
[3] Nouv. Arch. Mus. Paris (2) vol. 3, 1880, pp. 1–56, pls. 1–3.
[4] Bull. Soc. Zool. France, vol. 9, 1884, pp. 193–198.
[5] Ann. Mag. Nat. London (7) vol. 2, 1898, p. 415.
[6] Idem (7) vol. 8, 1901, pp. 114–116.
[7] Bull. Mus. Hist. Nat. Paris, vol. 6, 1900, pp. 98–101, 177–182, 384–354; vol. 7, 1901, pp. 328–332; vol. 10, 1904, pp. 221–223; vol. 12, 1906, pp. 467–471; vol. 14, 1908, pp. 347–349; vol. 15, 1909, pp. 66–68.
Bull. Soc. Philom. Paris (9) vol. 9, 1907, pp. 17–42, pl. 2 figs.; (9) vol. 11, 1909, pp. 184–190; (1) vol. 10, 1909, pp. 45–53; (3) vol. 10, 1911, pp. 276–277.
Bull. Soc. Zool. France, vol. 36, 1911, pp. 180–181; vol. 38, 1913, pp. 272–275; vol. 39, 1914, pp. 297–298.
Compt. Rend. Acad. Sci. Paris, vol. 156, 1913, pp. 1488–1489.
Compt. Rend. Assoc. Franc. Adv. Sci., 1915, 43 sess., pp. 500–505.

TORPEDO NARKE (Risso).

One example, 223 mm. N. Though largely faded the back uniform brownish, and under outer borders of pectorals and ventrals broadly brownish. Spiracle with obsolete papillae along edge. Hind caudal edge slightly convex.

ETHMALOSA DORSALIS (Valenciennes).

Two small examples. D. Also one in poor condition, small. N.

CLARIAS DUCHAILLUI Fowler.

Clarias duchaillui FOWLER, Proc. Acad. Nat. Sci. Phila., 1915, p. 226, fig. 7. Gabun.

The types, seven examples, examined. D.

FUNDULUS NISORIUS Cope.

Fundulus nisorius COPE, Trans. Amer. Philos. Soc., vol. 11, 1870, p. 456 Gabun.—FOWLER, Proc. Acad. Nat. Sci.Phila., 1916, p. 417 (types).

The types, 18 examples, examined. D.

APLOCHEILUS SEXFASCIATUS (Gill).

Epiplatys sexfasciatus GILL, Proc. Acad. Nat. Sci. Phila., 1862, p. 136. Gabun.

The types, 13 examples, examined. D.

FODIATOR ACUTUS (Valenciennes).

One example. N.

HYPORHAMPHUS SCHLEGELI (Bleeker).

One example in very poor condition, about 110 mm. long. N. It has ventral origin midway between pectoral origin and caudal base. Head from upper jaw tip about two-thirds of beak. Caudal peduncle wide as vertical pupil diameter. A. II, 13. A broad silvery-white band, especially along caudal peduncle side nearly wide as vertical pupil diameter.

Bleeker's *Hemiramphus schlegeli* [1] has priority over *Hemirhamphus calabaricus* Günther,[2] as long ago pointed out by Günther himself.[3]

SYNGNATHUS PELLEGRINI, new species.

Head, $3\frac{1}{8}$ to vent; D. 38; rings, 18+38; snout, $2\frac{1}{4}$ in head from upper jaw tip; eye, $2\frac{1}{4}$ in snout. Body slender, slightly wider than deep, greatly elongated; combined head and trunk $2\frac{3}{5}$ in tail. Body ridges distinct, without spines; that on upper lateral edge not con-

[1] Nat.Verhandel. Holl. Maats.Wet. Haarlem, vol. 18, 1863, No. 2, p. 120, pl. 25, fig. 1. *Ora aurifer*, Guinea.
[2] Cat. Fish. Brit. Mus., vol. 6, 1866, p. 266.
[3] Ann. Mag. Nat. London, ser. 3, vol. 18, 1866, p. 427.

tinuous with that on tail. Median lateral ridge of trunk not continuous with upper lateral ridge of tail. Head width one-fourth its length. Snout with least depth little nearer its tip than eye. Latter ellipsoid, front pupil edge nearly midway in head length. Lower jaw protrudes. Interorbital narrow or about half of eye-diameter, deeply concave. Opercle with short ridge, little inclined from horizontal, extends in front for about first fourth. Upper postocular ridge not quite to occiput. Median occipital ridge, well developed, extends back little beyond pectoral base or well over first body ring. Greater part of dorsal fin on tail, or base on 4 trunk and 6 caudal rings. Pectoral, $4\frac{1}{3}$ in head; caudal, 3. Color in alcohol largely uniform brownish; belly and lower surfaces of head and tail mostly paler. Iris slaty. No markings. Length, 113 mm.

Type.—No. 975, A.N.S.P. Gabun, West Africa. P. B. Du Chaillu.

Also Nos. 976 to 978, A.N.S.P., paratypes. These show: head, 3 to $3\frac{1}{5}$ to vent; D. 35 to 37; rings, 18 to 20+37 or 38; snout, $2\frac{1}{10}$ to

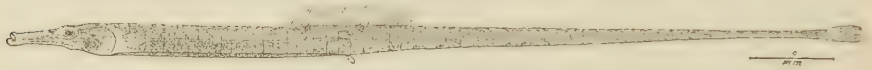

FIG. 11.—SYNGNATHUS PELLEGRINI.

$2\frac{1}{8}$ in head from upper jaw tip; eye, 2 to $2\frac{1}{2}$ in snout; length, 88 to 105 mm.

This species appears unique in its advanced dorsal.

(For Dr. Jacques Pellegrin of the Muséum national d'historie naturelle, Paris, author of many excellent papers on African fishes, in slight recognition of his studies on Gabun fishes.)

ISCHNOMEMBRAS GABUNENSIS Fowler.

Ischnomembras gabunensis FOWLER, Proc. Acad. Nat. Sci. Phila., 1904, p. 73, pl. 42. Gabun River.

Two examples, the types, examined. D. One now in the Field Museum at Chicago.

LIZA RAMADA (Risso).

Liza alosoides FOWLER, Proc. Acad. Nat. Sci. Phila., 1903, p. 746, pl. 45. Gabun River.

Seven examples, the types *of L. alosoides* Fowler, examined. D. Boulenger's suggestion [1] of the identity of *L. alosoides* with the present species is correct. A comparison of these types with the Ashantee material noticed previously in these pages shows they are nothing but young. They have the gill-rakers 22+28, but little less than filaments, or $1\frac{1}{4}$ in eye. The basal radii of the scales vary 6 to 9.

[1] Cat. Fresh-W. Fish. Africa, vol. 4, 1916, p. 84

HOLOCENTRUS ASCENSIONIS (Osbeck).

Four adult examples. N.

SPARUS AURATUS Linnaeus.

Head, $2\frac{4}{5}$; depth, $2\frac{1}{2}$; D. XII, 12; A. III, 11; scales, 48 in lateral line to caudal base and about 5 (?) more on latter; 5 scales above lateral line, 15 below; snout, $3\frac{1}{6}$ in head; eye, $2\frac{3}{4}$; maxillary, 3; interorbital, $3\frac{3}{4}$. Front teeth conic, some canine-like, and upper molars in two rows. Length, 50 mm. D.

EUCINOSTOMUS MELANOPTERUS (Bleeker).

One small example, 36 mm. long, in poor condition. Head, $2\frac{7}{8}$; depth, 3; D. IX, 10; A. III, 7. Premaxillary groove naked. D.

PSEUDUPENEUS PRAYENSIS (Cuvier).

Head, 3; depth, 3; D. VIII–I, 8; A. II, 6; scales, 28 in lateral line to caudal base and two more on latter; 2 scales above lateral line and 4 below; snout, $2\frac{1}{3}$ in head; eye, $3\frac{3}{5}$; maxillary, 3; interorbital, $4\frac{1}{8}$. Rakers, 4+19. Maxillary not quite to eye. Color in alcohol faded brownish. Length, 103 mm. N.

SPHEROIDES SPENGLERI (Bloch).

One, 30 mm. long (without caudal, which lost), and very poorly preserved. It has the rough area above beginning between the eyes and extending over predorsal about half way to dorsal fin. Spines larger and much more numerous over inflatable belly. N.

TETRODON PUSTULATUS Murray.

Head, $2\frac{4}{5}$; depth, $2\frac{1}{8}$; D. II, 9; A. II, 7; snout, $2\frac{1}{2}$ in head; eye, $3\frac{1}{2}$; interorbital, $2\frac{1}{3}$. Trunk compressed, also caudal peduncle, which latter with least depth about $1\frac{1}{2}$ its length or 3 in head. Head broad above; width, $1\frac{2}{5}$ its length. Snout obtuse, length about two-thirds its width. Eye large, impinging on upper profile, hind pupil edge about midway in head length. Teeth large, normal. Lips wide, fleshy. Nostril bifid tentacle close before eye, tentacle about half pupil length. Interorbital broad, level. Gill-opening about long as eye. Skin largely smooth; only inflatable belly with large and mainly concealed spines. Side and upper surface of head with many, mostly longitudinal, wrinkles. Back and upper part of sides with many fine wrinkles, mostly longitudinal. Dorsal inserted nearer caudal base than gill-opening; first branched ray 2 in head. Anal inserted slightly behind dorsal origin; first branched ray about 2 in head. Caudal truncate, $1\frac{1}{8}$ in head; pectoral, 2. Color in alcohol brown, paler to creamy-white below. Iris and fins pale brownish, with dorsal and caudal ends pale dusky. Length 50 mm. N.

SYACIUM GUINEENSIS (Bleeker).

Head, $3\frac{1}{4}$ to $3\frac{3}{4}$; depth, $2\frac{1}{6}$ to $2\frac{2}{5}$; D. 79 to 87; A. 60 to 64; scales, 43 or 44 (pockets) in lateral line to caudal base; snout 4 to $4\frac{1}{6}$ in head measured from upper jaw tip; lower eye, 4 to $4\frac{1}{3}$; maxillary, $2\frac{1}{3}$ to $2\frac{2}{5}$; caudal, $1\frac{1}{4}$. Contour rather ellipsoid. Least depth of caudal peduncle, $2\frac{1}{3}$ in total head length. Head width about $3\frac{1}{2}$ its length. Upper orbital socket little larger, slightly backward, and eyes very close or only divided by thin bony partition. Maxillary almost vertical. Lower jaw slightly protrudes. Teeth uniserial, simple, conic, larger forward and on blind side. No teeth on mouth roof. Preopercle edge entire. Rakers, 5+15, lanceolate, about half of filaments and latter $1\frac{1}{2}$ in eye. Scales all fallen, apparently 4 or 5 rows on cheek. Lateral line complete, median, nearly straight from shoulder to caudal base medially. Color in alcohol, on left side, brownish, and right side paler. Iris pale slaty. Length of three examples, 45 (?) to 70 mm. N.

Although Rochebrune [1] credits *Rhombus senegalensis* Kaup to Wiegmann (Arch., 1855), I can not find any reference to it in the volume for that year or in the register of names from 1835–1859.

SOLEA LASCARIS (Risso).

Head, $4\frac{3}{4}$; depth, $2\frac{1}{3}$; D. 80; A. 66; scales, about 115 (?) to caudal base in lateral line; about 24 scales above lateral line and 40 below; snout to lower eye, $2\frac{3}{4}$ in head, measured from upper jaw tip; mouth cleft, $3\frac{1}{2}$; lower eye, $1\frac{2}{3}$ in snout from its front edge; interorbital about equals vertical eye-diameter. Upper jaw with short lobe overhanging lower. Nostril on blind side about long as vertical eye-diameter, broadly bordered as rosette-like ring of papillae. Colored pectoral about $1\frac{3}{4}$ in head, pale pectoral about $2\frac{1}{6}$; caudal $1\frac{2}{5}$. Color in alcohol, right side uniform brownish. Pectoral with black blotch about middle. Iris slaty. Left side whitish. Length, 78 mm. N.

CYNOGLOSSUS GOREENSIS Steindachner.

Head, 5; depth, $4\frac{1}{4}$; D. 126; A. 89; scales, about 30+100 (?) in entire lateral line to caudal base; 17 scales above median lateral line at widest part of body to upper lateral line, 28 below; snout to lower eye, $2\frac{4}{5}$ in head measured from upper jaw tip; mouth cleft, $3\frac{2}{3}$. Color in alcohol with left side uniform brown, right side whitish. Length, 130 mm. N.

9. ANGOLA.

Günther first describes [2] new Angola fishes, Osorio has given a list of the marine species,[3] Regan describes a new *Denter*,[4] and, finally,

[1] Faune Senegamb., 1883–1885, p. 115.
[2] Ann. Mag. Nat. London, ser. 4, vol. 12, 1873, pp. 142–144.
[3] Jorn. Sci. Lisboa, ser. 2. vol. 2, 1890, pp. 50–60; ser. 2, vol. 3, 1893, p. 128.
[4] Ann. Mag. Nat. London, ser. 7, vol. 15, 1905, p. 325.

Boulenger has reported the extensive Ansorge collections.[1] The Eclipse expedition obtained material at Loando (São Paulo de Loanda); also the Quanza River, some at Cunga.

SARDINELLA AURITA (Valenciennes).

Head, $3\frac{1}{3}$ to $3\frac{3}{4}$; depth, $3\frac{1}{5}$ to $3\frac{4}{5}$; D. III, 15, rarely 14 or 16; A. II, 15 to 18, occasionally 19; scales 42 to 47 in median lateral count to caudal base and 4 to 6 more on latter; 14 scales transversely, seldom 13 or 15; ventral scutes, 17, sometimes 18 or 19+14, sometimes 15 or 16; snout, $3\frac{1}{4}$ to $3\frac{7}{8}$ in head, measured from upper jaw tip; eye, $3\frac{3}{5}$ to $4\frac{4}{5}$; maxillary, $2\frac{1}{4}$ to $2\frac{3}{4}$; interorbital, $3\frac{5}{6}$ to $4\frac{1}{3}$. Head width about half its length. Snout with preorbital adipose-like, width $1\frac{1}{8}$ to $1\frac{1}{4}$ its length. Eye with broad adipose-lids; hind pupil edge about midway in head length. Maxillary to pupil, or about first third in eye; expansion, $1\frac{1}{2}$ to $1\frac{3}{4}$. Median patch of fine teeth on tongue. Interorbital very slightly convex, or level medially. Rakers about 95 to 130+130 to 175, very fine or slender; about long as snout and filaments about three-fourths to seven-eighths of rakers. Color in alcohol with back dull olive-slaty; sides of head and trunk pale brassy. Fins brownish; pectoral with upper rays whitish, and caudal tips usually dusky to blackish; also origin and first two simple dorsal rays blackish. No dark spots on opercle edge. End of snout and mandible brownish. Length, 222 to 267 mm. Eight examples from Loando, besides two previously mentioned from Cape de Verde Islands.

The species exhibits variation in many respects, as in some examples the pectoral reaches three-fourths to ventral; in others two-thirds; striae on cheek numerous or sometimes obsolete; ventral longer or shorter, etc.

ETHMALOSA DORSALIS (Valenciennes).

Head, $2\frac{3}{4}$ to 3; depth, $2\frac{2}{5}$ to $2\frac{4}{5}$; D. III, 13 or 14, occasionally 15; A. II, 19, occasionally 17 or 18; scales in median lateral series from shoulder to caudal base, 37 to 42, and 4 or 5 more on latter; scales transversely to ventral keel 18, vary sometimes 16 to 19; ventral scutes, 16, sometimes 17+11 to 13; snout, 4 to $4\frac{3}{5}$ in head; eyes 5 to $5\frac{2}{5}$; maxillary, $2\frac{2}{5}$ to $2\frac{3}{5}$; interorbital, $3\frac{1}{5}$ to 4. Five example, from Loando and two from Sierra Leone at Freetown previously listed. Length, 286 to 323 mm.

The young Gabun examples have rakers about 38+90, while in the adults they are about 58+125.

CLARIAS GARIEPINUS (Burchell).

Head, $3\frac{7}{8}$ to $4\frac{3}{5}$; depth, $6\frac{2}{5}$ to 8; D. 66 to 73; A. 50 to 61; snout, $2\frac{3}{4}$ to $3\frac{1}{4}$ in head, measured to hind edge of gill-opening; mouth

[1] Ann. Mag. Nat. London, ser. 7, vol. 15, 1905, pp. 457–459; ser. 7, vol. 17, 1906, pp. 110–112; ser. 7, vol. 18, 1906, pp. 347–348; ser. 7, vol. 20, 1907, pp. 108–109; ser. 8, vol. 6, 1910, pp. 537–561.

width, 2⅔ to 2½; interorbital, 2 to 2¼; eye, 4½ to 5⅔ in interorbital. Body compressed, deepest at dorsal origin. Head width, 1¼ to 1⅓ its length, coarsely granular above, more so in half-grown. Snout wide, depressed; length about two-fifths to one-half its width. Eye small, at first third in head, or hind edge at first third in half-grown. Mouth broad, with fleshy papillose lips; under jaw shorter. Broad bands of villiform teeth in jaws and on vomer; band of upper jaw about three-fourths width of vomerine band. Nasal barbel about three-fifths to gill-opening; maxillary to middle of pectoral spine or four-fifths in half-grown; outer mental to pectoral origin and inner about two-thirds in head length. Width of long frontal, one-fourth its length; one-third in half-grown or 3¼ to 3½ times occipital fontanel. Occipital process triangular; length about two-thirds its base. Rakers about 15+76; lanceolate, fine, slightly longer than filaments or equal eye. Space between dorsal and caudal 1½ to 1⅘ eye-diameters. Dorsal begins slightly behind middle in space between pectoral and ventral origins in half-grown to last two-fifths in adults. Anal origin midway between hind fontanel edge and caudal base in half-grown or about midway between snout tip and last dorsal ray base in adult. Caudal, 1⅗ in head; pectoral, 1⅘ to 1⅞; ventral, 2 to 2⅖. Outer pectoral spine edge serrate, obsolete with age. Color in alcohol dull brownish, paler below. Seven examples, 303 to 406 mm., from the Quanza River at Cunga.

EUTROPIUS ECLIPSIS, new species.

Head, 4⅗; depth, 5; D. I, 6; A. II, 52; P. I, 10; V. I, 5; head width, 1½ its length; dorsal spine, 1⅖; pectoral, 1⅛; ventral, 2$\frac{1}{10}$; snout, 3 in head, measured from upper jaw tip; eye, 4¾; mouth width, 2; interorbital, 2.

Body elongate, rather slender, well compressed, deepest at spinous dorsal origin; predorsal trenchant and breast broad. Caudal peduncle strongly compressed, about long as deep, and least depth about 3⅜ in total head length.

Head broader below, converges above, and profiles alike. Snout broad; front edge but little convex as seen from above, and length in profile about two-fifths its width. Eye lateral, though equally visible above and below; upper edge level with closed tip of lower jaw, and hind edge slightly advanced before middle in head length. Mouth wide, lower jaw slightly protruding, and rami low. Teeth villiform, in broad bands in jaws and across vomer and palatines; latter continuous band slightly widens backward on each palatine. Tongue broad, thick, free around front edge. Barbels fine; long nasal reaching back behind eye or about 1⅗ in head; maxillary about half an eye-diameter beyond head; outer mental about an eye-diameter beyond eye, and inner mental about two-fifths length of

outer. Front nostril close to upper jaw edge, simple pore, about first fifth in snout length. Hind nostril close behind nasal barbel, or about midway in snout profile. Interorbital broadly convex. Occipital process long narrow ridge about two-thirds to dorsal origin, and meets dorsal buckler.

Gill-opening well forward or about to last fourth of snout in profile. Rakers 5 + 11, lanceolate, about three-fourths of filaments and latter one and one-half in eye.

Bones of head all covered with thin skin and with rather weak striae. Humeral process about 2⅔ pectoral spine, with a few striae. Lateral line complete, midway along side, deflected from caudal base downward.

Dorsal inserted about first third between mandible tip and caudal base, compressed slender spine with front edge smooth, and about 20 antrorse serrae on hind edge; first ray, 1¼ in head. Adipose fin

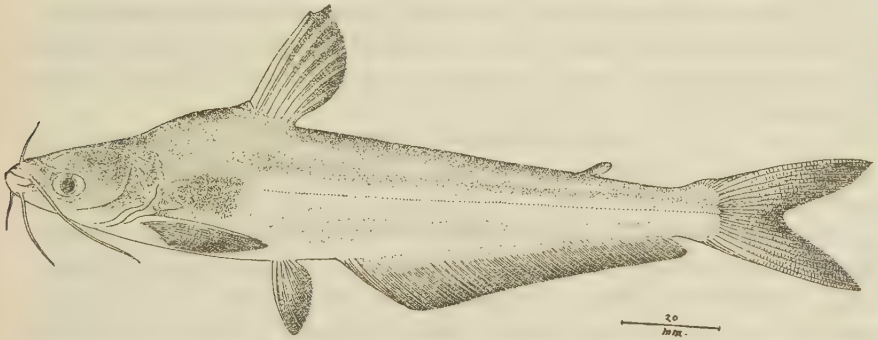

FIG. 12.—EUTROPIUS ECLIPSIS.

inserted about last two-fifths in space between depressed dorsal tip and caudal base, about long as eye. Caudal deeply forked (damaged), apparently with slender sharply pointed subequal lobes, both little longer than head. Anal inserted about midway between mandible tip and last anal ray base; front rays slightly longer or fourth branched about 2 in head. Pectoral not quite to ventral; spine like that of dorsal and hind edge with 18 antrorse serrae. Ventral insertion falls about opposite fourth dorsal ray base; fin small and reaches but little beyond front of anal. Vent close before anal.

Color in alcohol brown above, paler below on head, belly, and trunk, and silvery-white tinge along body below lateral line and above long anal. Fins and barbels all pale. Iris pale straw color. Above pectoral large dusky blotch, entirely before dorsal, and its extent about 1½ eye-diameters. Anal with an inconspicuous median longitudinal streak, its entire length, formed of minute dusky dots.

Length, 185 mm. (Caudal tips damaged.)

Type.—Cat. No. 42342, U.S.N.M. Quanza River at Cunga, Angola. William Harvey Brown. U. S. Eclipse Expedition, 1889.

Also Cat. No. 42341, same data, four paratypes. These show: Head, $4\frac{1}{2}$ to $4\frac{3}{4}$; depth $4\frac{3}{5}$ to $5\frac{1}{8}$; D. I, 6; A. II, 50 to 54; snout $2\frac{3}{5}$ to $3\frac{1}{8}$ in head measured from upper jaw tip; eye, $3\frac{1}{2}$ to $4\frac{3}{4}$; mouth width, 2 to $2\frac{1}{6}$; interorbital, $2\frac{1}{5}$ to $2\frac{1}{3}$; head width, $1\frac{2}{3}$ to $1\frac{3}{4}$; length, 130 to 150 mm.

This species is allied with *Eutropius ansorgii* Boulenger, which I have not seen. It appears to differ in the longer barbels, more slender body, fewer anal rays, and lower position of the eye.

(For the United States Eclipse expedition.)

CHRYSICHTHYS FURCATUS Günther.

Head, $3\frac{1}{5}$ to $3\frac{1}{4}$; depth, $4\frac{1}{5}$ to $4\frac{3}{4}$; D. I, 6; A. V, 10 or 11; snout, $2\frac{1}{8}$ to $2\frac{1}{4}$ in head; eye, $5\frac{1}{2}$ to $6\frac{1}{5}$; maxillary, 4; interorbital, 3; rakers, 8 + 14 or 15. Inner edges of lips strongly papillose. Maxillary barbel but little beyond eye, $1\frac{2}{3}$ in head. Adipose fin long as snout. Color in alcohol brownish above; sides and below with silvery-white reflections. Length, 382 to 418 mm.; two examples. Quanza River at Cunga.

CHRYSICHTHYS BOCAGII Boulenger.

Head, $3\frac{1}{4}$ to $3\frac{1}{3}$; depth, $4\frac{4}{5}$ to 5; D. I, 6; A. V or VI, 9 I or 10 I; snout, $2\frac{1}{3}$ to $2\frac{1}{2}$ in head; eye, 4 to 5; maxillary, $3\frac{3}{5}$ to $4\frac{1}{4}$; interorbital, $3\frac{1}{4}$ to $3\frac{3}{4}$; body slender, compressed. Head slightly wider than deep. Snout broad as long. Eye elevated, midway in head length. Mouth large, transverse; lower jaw much shorter. Lips thick, fleshy, papillose inside. Lower lip and chin papillose. Teeth villiform, in broad bands in jaws. Elongate band of villiform vomero-pterygoid teeth. Maxillary barbel, $1\frac{1}{4}$ in head. Outer mental barbel very slightly over half of head. Interorbital slightly concave, flattened medially. Rakers, 8 to 10 + 14 to 17. Fins large; depressed dorsal, $1\frac{1}{3}$ to adipose fin, last large. Caudal lobes, variably shorter or longer, usually lower trifle longer and larger. About 19 inner serrae on pectoral spine. Color in alcohol dull brownish above, sides and below silvery-white. Fins, dull uniform brownish. Length, 186 to 285 mm. Three from the Quanza River at Cunga.

GNATHONEMUS ANGOLENSIS Boulenger.

Head, $3\frac{7}{8}$ to 4; depth, 3 to $3\frac{3}{4}$; D. III, 22, seldom 21; A. III, 28, sometimes 29 or 30; scales, 50 or 51 in lateral line to caudal base and 5 or 6 more on latter; 10 or 11 scales above lateral line to dorsal origin, 10 to 12 below to anal origin; predorsal scales, 47 to 50; snout, 4 in head, measured from upper jaw tip; eye, 5 to $5\frac{2}{3}$; interorbital, 3 to $3\frac{1}{5}$. Body well compressed. Least depth of caudal peduncle, $1\frac{3}{4}$ to $1\frac{7}{8}$ its length, or $2\frac{3}{4}$ to 3 in head. Head width, $1\frac{7}{8}$ to 2 in its length. Snout

convex, length $\frac{7}{8}$ to 1 its width. Eye well advanced, hind profile about first two-fifths in head length. Mouth cleft very short, wide. Jaws with 5 conic teeth above in front and 6 below in front. Interorbital convex. Scales with 9 or 10 basal radii. Each caudal lobe scaly over basal two-thirds and 12 scales around caudal peduncle. Dorsal inserted little behind anal origin, slightly nearer caudal base than pectoral origin; first branched ray, $1\frac{7}{8}$ to 2 in head; that of anal, $1\frac{5}{6}$ to 2. Caudal well forked, about $1\frac{1}{8}$ in head; pectoral, $1\frac{1}{3}$ to $1\frac{2}{5}$, and ventral, $2\frac{1}{5}$. Color in alcohol, brownish above to silvery-white below. Fins all pale. Iris grayish. Four examples, 98 to 116 mm. Quanza River at Cunga.

One of the above examples is distorted, having the lateral line and apparently vertebral column in a somewhat sigmoid pattern.

BARBUS EUTAENIA Boulenger.

Head, $3\frac{3}{4}$ to $3\frac{7}{8}$; depth, $2\frac{7}{8}$ to $3\frac{1}{8}$; D. III, 8, once 7; A. III, 5; scales 23 to 25 in lateral line to caudal base and 2 more on latter, rarely 3; 5 scales above lateral line, 3 below, rarely 4; predorsal 9, rarely 10; snout, 3 to $3\frac{3}{4}$ in head; eye, $3\frac{4}{5}$ to 4; maxillary, $3\frac{2}{5}$ to 4; interorbital, $2\frac{4}{5}$ to 3. Body well compressed, back slightly elevated. Caudal peduncle well compressed, least depth about $1\frac{1}{2}$ to $1\frac{2}{3}$ its length, or $1\frac{2}{3}$ to $1\frac{4}{5}$ in head. Head width, $1\frac{2}{3}$ to $1\frac{3}{4}$ its width. Eye advanced, hind pupil edge at least midway in head length. Mouth small, closed lower jaw slightly included. Maxillary not quite to eye. Front barbel slightly larger than eye and hind one longer, or equals eye and space to hind nostril. Interorbital broadly convex. Rakers, 1+5 short points, about one-sixth of filaments, which $1\frac{1}{4}$ in eye. Pseudobranchiae about one-third of gill-filaments. Teeth 2, 3, 5—5 3, 2, some of larger hooked and with well-developed grinding surfaces. Scales with 3 to 5 basal scallops, 5 or 6 distinct basal radii, and about 4 or 5 apical radii. About 12 scales around caudal peduncle. Caudal base covered with small scales for at least two-fifths of lobe externally. Free axillary ventral scaly flap one-third of fin. Scales on breast moderately small, about 9 across between pectoral origins. Dorsal origin nearly an eye-diameter nearer snout tip than caudal base, or about midway in half grown examples. Dorsal spine with about 28 to 30 serrae along hind edge, variably little shorter or longer than head. Upper dorsal edge a little emarginate. Anal inserted little before depressed dorsal end or midway between ventral origin and caudal base, nearer ventral in half grown. Caudal well forked, usually an eye-diameter longer than head; pectoral, $1\frac{1}{8}$ to $1\frac{1}{4}$; ventral, $1\frac{1}{5}$ to $1\frac{1}{4}$.

Color in alcohol pale brownish generally, with bright or silvery reflections, and lower surface paler. Side of head, iris, and broad

ill-defined band along middle of side silvery white, with slightly leaden undershade at line within silvery area. Fins all pale brownish, ends of dorsal rays blackish. Fourteen examples, 118 to 148 mm. Quanza River.

These all differ from Boulenger's figure [1] as it does not show the caudal lobes scaled basally above and below, the upper dorsal edge not emarginate, while the dark median lateral band bends a little below, so to appear nearly concurrent with the lateral line, doubtless conditions of age.

BARILIUS ANSORGII Boulenger.

Two examples, 83 to 105 mm., labeled "West Africa," from the Eclipse Expedition, are included here as they may have been obtained in Angola. Head, 3½ to 3¾; depth, 3¾ to 4¼; D. II, 7; A. III, 13 or 14; scales 40 or 41 in lateral line to caudal base and 3 more on latter.

ALESTES ANSORGII Boulenger.

Head, 4 to 4⅖; depth, 3½ to 3⅘; D. II, 8; A. III, 17 to 19; scales, 34 to 38 in lateral line to caudal base and 2 or 3 more on latter; 6 scales above lateral line, 3 below to anal; predorsal scales, 15 to 17; snout 3 to 3½ in head; eye, 3⅓ to 4; maxillary, 2⅞ to 3⅓; interorbital, 2⅔ to 3. Elongate, slightly ovoid or lower profile more convex, deepest at ventral origin. Caudal peduncle compressed, about deep as long; least depth, 2¼ to 2¾ in head. Head width, 1⅔ to 2 in its length. Snout conic; length, three-fourths to four-fifths its width. Eye large, with broad adipose lid, advanced or hind pupil edge slightly before center in head length. Mouth broad, gape short or to nostrils, about midway in snout length. Lips thick, tough. Upper teeth in 2 rows, 6 outer smaller with 3 to 5 points; 7 inner broader with 7 or 8 points; and in all median point largest. Lower teeth 8, large except last lateral, with 5 to 7 points, and median point enlarged. Also pair of smaller conic teeth, close inside, outer medially. Maxillary extends slightly behind nostril, not quite to eye. Nostrils together, midway in snout length. Interorbital convex. Broad suborbitals not completely covering cheek, leave narrow naked strip below. Rakers, 11+17, lanceolate, rather flexible, 2 in filaments, 1⅗ in eye. Scales large; basal striae 1 to 5 and apical 2 to 6; fewer in half-grown. Dorsal origin midway between snout tip and caudal base; slightly more advanced in half-grown; first branched ray, 1⅓ to 1⅙ in head. Adipose fin, 1⅛ to 1⅓ in eye. Anal inserted about opposite depressed dorsal tip, slightly advanced in half-grown; first branched ray, 1⅘ to 2 in head. Caudal well forked, lower lobe slightly longer, 1+⅓ to 1+¼ in head; pectoral, 1⅛ to 1⅙, ventral, 1⅓ to 1⅖. Color in alcohol uniform brownish above, sides and fins all paler. Body with silvery reflections, but no dark blotches on

[1] Cat. Fresh-Water Fish. Africa, vol. 2, 1911, p. 131, fig 108.

paired fins. Four examples from the Quanza River at Cunga, 133 to 349 mm.

GYMNOTHORAX MORINGUA (Cuvier).

Head, 3⅛ to vent; head and trunk combined, 1¼ in tail; eye, 1¼ in snout; mouth, 2⅕ in head. Snout conic; width, 1¼ in its length. Eye over middle in gape. Jaws closing, lower slightly included. Teeth uniserial, large, 3 large depressible canines in median row above in front. Short row of small vomerine teeth. Nasal tube long as vertical pupil diameter. Interorbital about three-fourths of eye. Dorsal begins at last two-fifths between rictus and gill-opening. Color in alcohol rather coarsely mottled with deep brown on whitish general color. Length, 202 mm. One from "West Africa," obtained by the *Eclipse* expedition.

Agrees with an example, 173 mm. long, from St. Martins Island, Dutch West Indies, in almost every respect.

ECHIDNA CATENATA (Bloch).

Head, 3⅞ to 4½ to vent; tail, 1¼ to 1⅓ in combined head and trunk; eye, 1½ to 1⅗ in snout; mouth, 2⅘ to 3⅛ in head; head width, 3⅖ to 3¾. Snout conic, about long as wide. Eye center about opposite last third in gape; more advanced in young. Jaws closing, form rather blunt even muzzle. Teeth in jaws uniserial in front, where first 6 and front median enlarged; hind ones smaller and biserial. Row of 3 large median vomerine teeth. Lower teeth biserial in front, uniserial behind, and inner front row enlarged. Nasal tube long as vertical pupil diameter. Eye less than interorbital, which wider with age. Dorsal begins close before gill-opening. Color in alcohol deep brown, reticulated with narrow yellowish lines, on trunk laterally largely at vertical cross lines, usually broken into blotches below. In young examples white below, dominant and dark blotches diminish, the white areas often finely dotted or spotted with brownish. Three examples, 158 to 273 mm. from "West Africa."

Compared with three others from St. Martins, Dutch West Indies, no specific differences were found.

FODIATOR ACUTUS (Valenciennes).

Head, 3⅔; depth, 4⅘; D. 1, 9, 1; A. 1, 10; scales (pockets), about 50 in lateral line to caudal base, or about 43 from shoulder to caudal base medially; about 23 scales (pockets) before dorsal; 6 scales (pockets) above lateral line to dorsal origin; snout, 2⅓ in head from upper jaw tip; eye, 3½; maxillary, 4¾; interorbital, 3½.

Body elongate, compressed, flattened sides converge below, deepest about midway in length. Head similar, well pointed. Snout long, conic; width 1½ its length. Eye ellipsoid, midway in head, 1½ in snout. Mouth small, lower jaw produced in short beak for space

about three-fifths of horizontal pupil diameter beyond snout. Maxillary not entirely concealed behind by preorbital, about three-quarters to nostril. Teeth minute, in villiform bands in jaws; upper band much broader. Nostrils an elongate slit long as horizontal pupil-diameter. Interorbital level. Rakers, 8+25, lanceolate, about three-quarters of filaments, latter about two-thirds of eye. Scales caducous, narrowly exposed, each with about 3 marginal striae to 2 basal lobes. Dorsal origin midway between ventral origin and last dorsal ray base; depressed fin slightly beyond caudal base. Anal inserted about opposite first branched dorsal ray base. Caudal well forked, lower lobe (damaged) apparently long as head (?). Pectoral reaches fourth branched dorsal ray, $1\frac{7}{8}$ in body without caudal. Ventral, $1\frac{2}{3}$ in head, reaches vent close before anal.

Color in alcohol with back above pectoral and head above eye brownish; sides and below silvery-white. Iris whitish. Dorsal and pectoral blackish, deepest over outer portions, and rays of former pale or whitish basally. Caudal pale brown. Ventral and anal whitish. Length 143 mm. Loando.

An example, already listed from the Gabun, a little smaller and in poor preservation, shows: head, $3\frac{1}{3}$; depth, 4; D. I, 9; A. I, 10; scales (pockets), 43 from shoulder to caudal base medially; snout, $2\frac{7}{8}$ in head; eye, 3; maxillary, $4\frac{1}{3}$; interorbital, $3\frac{1}{8}$. Lower jaw extends beyond snout tip about three-fifths of eye-diameter horizontally. Rakers, 6+23 (?). Eye about seven-eighths of snout. Closed maxillary not entirely concealed. Ventral origin about midway between front eye edge and caudal base. Pectoral reaches first two-fifths in dorsal base, $1\frac{7}{8}$ in body without caudal. Anal inserted little before pectoral tip.

No differences could be noted in comparison of the above with an example in the Academy, from Panama.

HEMIRAMPHUS BRASILIENSIS (Linnaeus).

Head, from snout tip, $4\frac{1}{4}$ to $4\frac{3}{5}$; depth, $5\frac{2}{3}$ to $6\frac{1}{5}$; D. II, 11, rarely II, 12; A. II, 9 to 11, rarely 8; scales, 55 to 60 in lateral line to caudal base, though last 2 to 7 without tubes, and 6 to 8 more scales over caudal base; 38 to 44 predorsal scales to head; snout, $2\frac{7}{8}$ to 3 in head from upper jaw tip; eye, 4 to $4\frac{2}{3}$; maxillary, $3\frac{1}{2}$ to 4; interorbital, $3\frac{2}{3}$ to 4.

Body well compressed; sides flattened. Caudal peduncle with least depth about three-fourths its length. Head pointed, compressed, flattened sides but slightly converging below. Snout conic; width, $1\frac{1}{3}$ its length. Eye large, little advanced, though hind pupil edge slightly behind middle in head length. Maxillary, $\frac{3}{4}$ to eye. Teeth fine or in minute bands in jaws; none in mouth roof. Mandible about long as rest of head. Nostril large, close before upper front

eye edge. Interorbital depressed, scarcely or very slightly convex. Rakers about 10+25, lanceolate, nearly three-fourths of filaments, and latter about two-thirds of eye. Isthmus narrow frenum. Scales largely caducous, all narrowly imbricated, very deep along side; circuli very fine and mostly continuous above and below. Top of head with two longitudinal arborescent areas in each mastoid region. Lateral line not complete beyond middle of caudal peduncle; large tubes arborescent below. Dorsal inserted about last fourth in space between hind eye edge and caudal base; in smaller examples at last fourth between front eye edge and caudal base; last branched ray about $1\frac{2}{3}$ of first. Anal inserted near first third of dorsal base; fin small. Caudal well forked; upper lobe about three-fourths of lower. Pectoral large, $2\frac{1}{4}$ to ventral; about $2\frac{4}{5}$ in younger. Ventral inserted much nearer caudal than pectoral base.

Color in alcohol dull olive-brown on back, sides, and below paler or silvery white. Underlaid leaden band along dark color of back, not quite wide as pupil, from shoulder to caudal base. Dorsal, caudal, and pectoral pale brownish; other fins whitish. Iris pale. Length, 305 to 382 mm. (Caudal tips and beaks of several damaged.) Loando. Six examples.

These fall into two groups, one with longer pectorals and slightly fewer anal rays, or 8 to 10 branched contrasted with 11 branched in the short-pectoral pair of examples. The long pectoral having been offered as an alleged character for several closely allied species, an examination of the following material in the Academy results.

A Porto Rico specimen, 254 mm. long, shows the pectoral about $1\frac{1}{6}$ in head from upper jaw tip, 10 branched anal rays, and rakers 9+25. Three Hawaiian examples, largest 355 mm., all have a long pectoral, which about long as head without beak, 10 or 11 branched anal rays, and rakers 11+25. They represent *H. depauperatus*, Lay and Bennett,[1] and do not appear to differ in any but trivial characters from the African examples. Of three small New Jersey examples, largest 190 mm., the pectoral is $1\frac{1}{3}$ to $1\frac{2}{3}$ in head; branched anal rays 11, and rakers 12+25. Another example I obtained in Chesapeake Bay, 328 mm. long, has pectoral $1\frac{1}{2}$, branched anal rays 11, and rakers 8+22. An examination of scales from examples representing all of the above, besides others from other parts of the West Indies, reveals no grounds for specific distinctions. The circuli are all very fine and complete.

The only distinction for *Hemirhamphus balao*, Le Sueur,[2] which is described with "the tail yellow and bluish," appears to be the "caudal fin black." *Hemirhamphus macrochirus*, Poey,[3] is based

[1] Zool. Beechey's Voy., 1839, p. 66. Oahu.

[2] Journ. Acad. Nat. Sci. Phila., vol. 2, 1823, p. 136. Caribbean Sea near Guadeloupe, Martinique, and Domingo.

[3] Memor. H. N. Cuba, vol. 2, 1861, p. 29

on examples 280 to 290 mm. long, with the eye 4 in head, pectoral $1\frac{4}{5}$ in body depth, and upper caudal lobe violet. *Hemiramphus guineensis*, Bleeker,[1] certainly to be referred to my African material, is another synonym as long pointed out by Günther. Bleeker's figure is faulty in that it shows the lateral line continuous to the caudal base.

MUGIL CUREMA Valenciennes.

Head, $3\frac{3}{4}$; depth $3\frac{2}{5}$ to $3\frac{1}{2}$; D. IV–I, 8; A. III, 9; scales, 38 from shoulder to caudal base; 12 scales transversely between soft dorsal and anal origins; 28 to 30 predorsal scales; snout, $3\frac{2}{3}$ to 4 in head; eye, $3\frac{2}{3}$ to 4; maxillary, $3\frac{1}{2}$ to 4; interorbital, $2\frac{1}{4}$ to $2\frac{2}{5}$. Body well compressed, deepest at spinous dorsal origin. Least depth of caudal peduncle $1\frac{1}{10}$ to $1\frac{1}{4}$ its length, or $2\frac{1}{4}$ to $2\frac{2}{5}$ in head. Head width, $1\frac{2}{5}$ its length. Snout length half its width. Adipose eyelid broad, and hind eye edge about midway in head length. Each lip with row of fine or small cilliform teeth, and above inner imperfect row. Maxillary to hind nostril, well exposed. Interorbital broadly convex. Preorbital edge minutely serrate. Rakers 35+60, fine, lanceolate, 2 in filaments which about $\frac{7}{8}$ of eye. Scales with about 10 basal radii. Soft dorsal and anal densely scaly to edges, and caudal scaly except hind edge. Spinous dorsal inserted about midway between snout tip and caudal base, first spine $1\frac{3}{4}$ to $1\frac{7}{8}$ in head. Soft dorsal inserted well behind anal origin, or about midway between spinous dorsal origin and caudal base. Anal inserted behind depressed spinous dorsal tip, first branched rays longest. Caudal deeply forked, about $1\frac{1}{6}$ to $1\frac{1}{5}$ in head, pectoral $1\frac{1}{4}$ to $1\frac{1}{3}$, ventral $1\frac{2}{3}$ to $1\frac{2}{3}$. Color in alcohol olive-brown, paler below. Fins all pale brownish, pectoral base slightly leaden and hind caudal edge dusky. Length of two examples from Loando, 172 to 182 mm.

These specimens agree entirely with American. An example, 165 mm., from Santo Domingo, West Indies, has rakers 36+54. The species is interesting as an addition to the fauna of West Africa.

LIZA SALIENS (Risso.)

Head, $3\frac{1}{2}$ to $3\frac{7}{8}$; depth, $3\frac{1}{2}$ to $3\frac{7}{8}$; D. IV–I, 8; A. III, 9; scales, 34 to 38, from shoulder to median caudal base and 6 more on latter; 13 or 14 scales between soft dorsal and anal origins; 25 to 28 predorsal scales; snout, $3\frac{2}{3}$ to $3\frac{3}{4}$ in head; eye, $4\frac{1}{2}$ to $4\frac{2}{3}$; maxillary, $3\frac{3}{5}$ to $4\frac{1}{6}$; interorbital, $2\frac{2}{3}$ to $2\frac{3}{4}$. Body moderately long, well compressed, deepest about spinous dorsal origin. Caudal peduncle well compressed, least depth, $1\frac{1}{5}$ to $1\frac{1}{3}$ its length, or $2\frac{1}{8}$ to $2\frac{1}{3}$ in head. Head width, $1\frac{3}{4}$ to 2 in its length. Snout wide, length about three-fifths its width. Eye advanced, hind edge about midway in head.

[1] Nat. Verhandel. Holl. Maats. Wet. Haarlem, vol. 18, 1863, No. 2, p. 119, pl. 25, fig. 2. Annonkor Boutry, Guinea.

Mouth wide, would form obtuse angle. Row of minute ciliate teeth in upper jaw. Maxillary exposed, not quite reaching eye. Nostrils close together, front one about midway in snout length. Interorbital broadly convex. Preorbital denticulate at end, few largely concealed denticles along lower edge. Rakers about 30+50, finely lanceolate, about two-thirds of filaments. Scales with 8 to 10 basal radii. Cheek with three rows of scales. No axillary pectoral flap. Anal largely scaly over basal portion; soft dorsal naked, and 3 or 4 scales behind depressed spinous dorsal tip and soft dorsal origin. Spinous dorsal inserted about midway between center in snout length and caudal base, or nearly midway between front pupil edge and caudal base in smaller example, second or longest spine 2 to $2\frac{1}{4}$ in head. Soft dorsal inserted little nearer spinous dorsal origin than caudal base, first ray $1\frac{3}{4}$ to 2 in head, first anal ray $1\frac{3}{5}$ to 2. Caudal well forked, long as head or half an eye-diameter longer, pectoral $1\frac{1}{5}$ to $1\frac{1}{3}$, ventral $1\frac{3}{5}$ to $1\frac{2}{3}$. Color in alcohol pale olive-brown above, sides and below brownish with silvery-white tints. Fins pale brown, hind caudal edge little dusky. Iris pale. Four examples, 178 to 203 mm., from Loando.

My only conformable example from Italy, about 205 mm., shows 9 scales behind its short depressed spinous dorsal, while in a young Italian example there are 6, though none of the Loando examples have over 5.

SPHYRAENA SPHYRAENA (Linnaeus).

Head, $3\frac{1}{5}$; depth, $7\frac{3}{4}$; D. V–I, 1, 8; A. II, 1, 8; scales, 144 in lateral line to caudal base and 7 more on latter; snout $2\frac{1}{3}$ in head from upper jaw tip; eye, 6; maxillary, $2\frac{3}{4}$; interorbital, $4\frac{3}{4}$. Muzzle conic; lower jaw projecting beyond upper about half an eye-diameter; mandible, $1\frac{7}{8}$ in total head length. Head width, $3\frac{2}{5}$ its length. Maxillary reaches nostrils. Scales behind eye to preopercle edge, 17. First dorsal inserted about opposite ventral origin and pectoral three-fourths of space to latter; 3 in head. Least depth of caudal peduncle, $5\frac{1}{5}$ in head; lower caudal lobe, $1\frac{3}{4}$. Length, 407 mm. Loando.

Compared with three smaller Italian examples the scales of the African example have coarser radiating striae, doubtless due to age.

HOLOCENTRUS HASTATUS Cuvier.

Head, $3\frac{1}{5}$ to $3\frac{1}{3}$; depth, 3 to $3\frac{1}{3}$; D. XI, 15, rarely 14; A. IV, 10; scales in lateral line 48 to 51 to caudal base and 6 to 8 more on latter; 5 scales above lateral line and 8 below; snout, $3\frac{7}{8}$ to $4\frac{1}{5}$ in head; eye, 3 to $3\frac{1}{6}$; maxillary, $2\frac{1}{6}$ to $2\frac{1}{2}$; interorbital, $2\frac{3}{4}$ to $3\frac{1}{5}$.

Body elongately ellipsoid, deepest at depressed pectoral tip. Caudal peduncle compressed; least depth half its length, or $3\frac{2}{5}$ to 4 in head. Head width about $1\frac{7}{8}$ its length. Snout convex, length about three-fourths to four-fifths its width. Eye advanced, pupil

slightly before center in head length. Mouth small; lower jaw included slightly in upper. Maxillary to eye center, expansion 1¾ to 2 in eye. Teeth fine, conic, in bands in jaws, on vomer and palatines. Nostril about midway in snout. Interorbital level, with superciliary and 2 median longitudinal bony ridges. Opercular spines 2, short, of equal length, and spine at preopercle angle about twice as long. Serrae strong on preopercle, opercle, suborbital and preorbital ridges and edges. Rakers v, 4 + 14, lanceolate, equal filaments, or 2 in eye. Scales narrowly imbricate; basal lobes 4 or 5; apical serrae, 16 to 18, and striae all parallel vertically. Cheeks with 5 rows of scales. Tubes in lateral line simple. Spinous dorsal inserted over pectoral origin; fourth spine 1⅞ to 2 in head. Soft dorsal origin much nearer caudal base than pectoral origin, or at last third between hind pupil edge and caudal base; second ray, 1½ to 1⅝ in head. Anal opposite dorsal, similar; third spine, 1⅞ to 2 in head; first ray, 1¾ to 2. Caudal strongly forked, 1⅓ to 1⅔ in head; pectoral, 1½ to 1⅗; ventral, 1¼ to 1⅓.

Color in alcohol faded dull brownish, apparently each row of scales with pale streak. Back gray-brown, line of demarcation along close below lateral line. Lower surface with dull brassy tint. Iris and side of head dull brassy-brown. Fins pale brown; some smaller examples with dusky tint on outer portion of membranes between first and second dorsal spines, and another between tenth and eleventh. Length of 6 examples, 84 to 96 mm. Loando.

Cuvier's figure does not show the black spot between first two dorsal rays as mentioned in his text relative to his first example, which without locality. The figure also shows the third anal spine twice length of fourth and opercular flap behind the long opercular spine black.

TRICHIURUS LEPTURUS Linnaeus.

Six examples from Loando.

CARANX ANGOLENSIS, new species.

Head, 3⅕; depth, 4; D. VIII—I, 31; A. II—I, 27; P. II, 20; V, I, 5 scales, 53 in curved lateral line, and 39 in straight portion with 8 of latter on caudal base; head width, 2⅓ its length; mandible, 2; third dorsal spine, 2⅛; first dorsal ray, 2¼; first anal ray, 2⅓; upper caudal lobe, 1⅘; pectoral, 1⅛; ventral, 2 1/10; snout, 3¼ in head, measured from upper jaw tip; eye, 3⅜; maxillary, 2⅝; interorbital, 3¼.

Body well compressed, elongately fusiform, front profiles evenly convex and lower slightly more so behind to greater depth at spinous anal origin. Caudal peduncle slender, moderately depressed, least depth 2 and least width 3 in its length.

Head well compressed, moderate in depth, pointed, and flattened sides converge more below. Snout conic, width 1⅛ its length. Eye

moderate, advanced, elevated, and hind pupil edge about midway in head length measured from upper jaw. Mouth oblique, gape nearly straight, and mandible well protruded. Lips fleshy, somewhat narrow. Maxillary to eye and upper edge not entirely slipping below preorbital, terminal expansion 2 in eye. Short oblique groove down from behind hind maxillary end when mouth closes. Teeth small, sharp pointed, uniserial largely, though at least two rows in front of each jaw. Bands of similar teeth on vomer and palatines. Tongue long, rather slender, free and round in front, with two elongate patches of minute simple teeth. Mandibular rami well elevated inside mouth. Nostrils together, similar, or hind one but slightly larger, fall at last third in snout. Interorbital broadly convex, median keel rising close behind hind nostril and extends to spinous dorsal. Opercle with few striae above and forward.

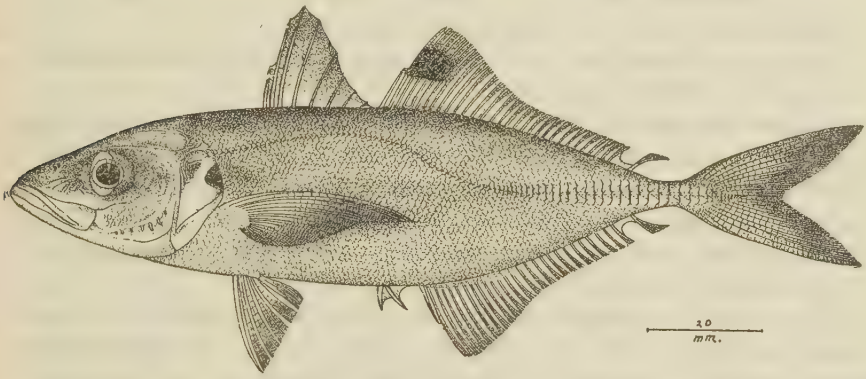

FIG. 13.—CARANX ANGOLENSIS.

Gill-opening extends forward about midway in space between hind nostril and front eye edge. Rakers, 16 + 37, slender, lanceolate, slightly longer than filaments, or three-fifths of eye. Pseudobranchiae nearly two-fifths of eye. Isthmus long narrow triangle, each edge slightly raised.

Scales very caducous, with moderate concentric circuli. Head largely scaly; snout, mandible, and lips naked. Spinous dorsal with low basal scaly sheath, and front of soft dorsal and anal each with scaly basal sheath. Caudal base scaled, also pectoral base. Straight portion of lateral line begins after elevated dorsal rays. Scutes moderate, deepest 5 in greatest body depth.

Spinous dorsal small; slender spines pungent; third longest, with second and fifth subequal, depressible in a groove and reaching soft dorsal origin. Spinous dorsal inserted about over first fifth in pectoral length, or nearly midway between eye center and depressed pectoral tip. Soft dorsal inserted nearly over last fifth in depressed pectoral, or nearly midway between hind nostril and caudal base.

First few front rays moderately elevated, graduated down from first or longest ray. Anal spines short, depressible in groove, posterior little longer, origin of fin opposite that of soft dorsal. Soft anal, like soft dorsal, inserted about opposite pectoral tip, or about midway between hind eye edge and caudal base. Caudal well forked, small slender lobes (damaged) apparently pointed and equal. Pectoral moderately long, falcate, origin about level with lower eye rim. Ventral moderate, little longer than post-ocular region. Vent close before spinous anal origin, well behind ventral tips.

Color in alcohol dull brownish with somewhat leaden tint on back, sides and lower surface whitish, with silvery reflections. Black blotch on upper opercle edge not quite deep as vertical pupil-diameter. Fins all pale brownish, except large black blotch on dorsal near tip and along front edge, its diameter slightly less than eye. Iris yellowish. Peritoneum pale.

Length about 140 mm. (caudal tips damaged).

Type.—Cat. No. 42301 U.S.N.M. Loando, Angola. Wm. Harvey Brown, U. S. Eclipse Exp. 1889.

Besides the above, also Nos. 42302 and 42300, including five paratypes, same data. These show: head, $3\frac{1}{5}$ to $3\frac{1}{3}$; depth, $3\frac{1}{3}$ to $3\frac{7}{8}$; D. VIII—I, 31, sometimes 29 or 32; A. II—I, 27 or 28: scutes, 33 to 39 in straight section of lateral line; snout, 3 to $3\frac{1}{3}$ in head from upper jaw tip; eye, $3\frac{2}{5}$ to $3\frac{1}{2}$; maxillary, $2\frac{3}{5}$ to $2\frac{3}{4}$; interorbital, $3\frac{3}{5}$ to $3\frac{3}{4}$; length, 120 to 137 mm.

This species is allied with *Caranx ruber* (Bloch) from the West Indies and falls within the subgenus *Elaphrotoxon*. It differs strikingly, however, upon comparison, in the last dorsal and anal rays being semidetached or at least much further separated from their penultimate rays, suggestive of *Decapterus*. These last isolated rays are, however, connected by at least basal membranes with their antecedents.

Caranx sanctae-helenae Valenciennes[1] is doubtfully referred by Günther[2] to *Caranx maruadsi* Schlegel. Valenciennes gives more dorsal (35) and anal rays (30). He says the last dorsal and anal rays each form a "fausse nageoire bien distincte." The scutes are in agreement with my Loando examples. If a *Decapterus*, as allowed by Poey, it is not satisfactorily defined.

(Named for Angola.)

POMADASIS SUILLUM (Valenciennes).

Head, $2\frac{3}{4}$ to $2\frac{4}{5}$; depth, $2\frac{3}{5}$ to $2\frac{7}{8}$; D. X or XI, I 16, rarely 15; A. III, 8, sometimes 9 or 10; scales 50 to 54 in lateral line to caudal base and 9 to 14 more on latter; 5 to 7 scales above lateral line to

[1] Hist. Nat. Poiss., vol. 9, 1833, p. 28. Sainte-Hélène.
[2] Cat. Fish. Brit. Mus., vol. 2, 1860, p. 428.

soft dorsal origin and 12 to 15 below; snout, 3 to 3½ in head; eye, 3½ to 4½; maxillary, 3½ to 3⅔; interorbital, 3⅞ to 5. Back little elevated, body well compressed; least depth of caudal peduncle, 1⅕ to 1¼ its length, or 3⅕ to 3⅜ in head. Head width, 2⅛ to 2½ its length. Snout conic, long as wide, little longer in young. Eye little advanced or hind pupil edge midway in head length. Mouth small, well inclined, lower jaw slightly included. Maxillary to front nostril, to hind nostril in young. Bands of fine teeth in jaws. Interorbital convex. Hind preopercle edge with 16 denticles, lower larger. Rakers, II 6+16, lanceolate, about 2 in filaments and latter 1½ in eye. Scales with 8 to 10 basal striae. Scales smaller along body edges and fin bases. Tubes in lateral line simple. Dorsal spines strong, third, 2⅙ to 2⅓ in head; second ray, 2⅔ to 2⅞. Second anal spine longest, 2 to 2¼ in head, always slightly longer than third, first ray, 2¼ to 2½. Caudal emarginate, 1¼ to 1⅓ in head; pectoral, 1 1/10 to 1⅛; ventral, 1⅔ to 1⅘. Color in alcohol brownish on back, sides and below silvery-white. Back above lateral line with many dark obscure spots, rather irregular and broken into blotches though mostly in oblique rows. Pale lengthwise subbasal streaks on dorsals with pale brown above and below. Round deep brown blotch on opercle above, slightly less than eye. Eight examples, 140 to 175 mm. Loando.

In this and the following species the long anal spines are always shorter than the first anal ray, whereas in *P. jubelini* the second at least is longer. The following species differs from *P. suillum* in the second spine constantly subequal with the third, and the increased anal rays.

POMADASIS BENNETTII (Lowe).

Head, 2⅔ to 2⅞; depth, 2⅔ to 2¾; D. XI, I, 16; A. III, 12; scales, 52 to 54 in lateral line to caudal base and 6 to 8 more on latter; 7 or 8 scales above lateral line to soft dorsal origin and 13 below; snout 3⅛ to 3⅔ in head; eye, 3 to 3½; maxillary, 3⅛ to 3⅞; interorbital, 3⅞ to 4¼. Back scarcely elevated and least depth of caudal peduncle slightly greater than eye. Head width about 2¼ its length. Snout conic, about long as wide. Eye little advanced or hind pupil edge about midway in head length. Mouth small, lower jaw slightly included. Maxillary to front nostril. Bands of fine teeth in jaws. Interorbital slightly convex. Hind preopercle edge with 23 denticles. Rakers II, 6+12, III, lanceolate, about 2 in filaments or 4 in eye. Scales with 7 or 8 basal striae. Scales smaller along fin bases and body edges. Tubes in lateral line simple. Third dorsal spine, 2¼ in head; first dorsal ray, 2¾; second anal spine, 2⅖; first anal ray, 2. Caudal emarginate, 1¼ in head; pectoral; 1⅛; ventral, 1⅗. Color in alcohol brownish on back, sides, and below silvery-white; above lateral line traces of deeper brown obsolete dots or small spots. Fins all brown-

ish, spinous dorsal tinged with dusky. Two examples, 83 to 137 mm., one from Loando and the other from Elmina, Ashantee.

DENTEX MACROPHTHALMUS (Bloch).

Head, $2\frac{3}{5}$ to $2\frac{3}{4}$; depth, $2\frac{1}{4}$ to $\frac{2}{5}$; D. XII, 10, 1; A. III, 8, 1; scales, 52 or 53 in lateral line to caudal base and 6 or 7 more on latter; 6 scales above lateral line, 13 below; snout, $3\frac{1}{3}$ to $3\frac{7}{8}$ in head; eye, $3\frac{1}{5}$ to $3\frac{1}{2}$; maxillary, $2\frac{1}{2}$ to $2\frac{3}{5}$; interorbital, $3\frac{3}{4}$ to 4; rakers, 9 to 11+17 or 18. Cheek with 7 rows of scales. Length of 3 examples, 298 to 325 mm. Loando.

These agree well with a small Italian example.

PAGELLUS ERYTHRINUS (Linnaeus).

Head, $2\frac{9}{10}$; depth, $2\frac{2}{5}$; D. XII, 10, 1; A. III, 10, 1; scales, 55 in lateral line to caudal base and 5 more on latter; 4 scales above lateral line to second dorsal origin, 13 below; snout, 3 in head; eye, $3\frac{2}{3}$; maxillary, 3; rakers IV, I+10, lanceolate, half of filaments and latter $1\frac{4}{5}$ in eye; length, 200 mm. Loando.

Agrees with a series of Mediterranean examples of all ages, which show rakers 4 or 5+8 to 10. The scales of all show 8 or 9 basal striae.

PAGELLUS MORMYRUS (Linnaeus).

One from Loando.

DIPLODUS SARGUS (Linnaeus).

One example. Loando.

TILAPIA ANDERSONII (Castelnau).

Head, $2\frac{5}{6}$ to $2\frac{7}{8}$; depth, $2\frac{2}{5}$; D. XV or XVI, 11 or 12; A. III, 8 to 11; scales, 19 to 21 in upper section of lateral line, 10 to 13 in horizontal section to caudal base and 2 or 3 more on latter; 3 scales above upper lateral line to soft dorsal origin, 8 below from horizontal lateral line to spinous anal origin; 9 or 10 predorsal scales; snout $2\frac{3}{5}$ to 3 in head; eye, $3\frac{2}{5}$ to $4\frac{2}{3}$; maxillary, $3\frac{2}{3}$ to $3\frac{1}{2}$; interorbital, $2\frac{3}{5}$ to 3. Body elongately ellipsoid. Least depth of caudal peduncle, $2\frac{1}{8}$ to $2\frac{1}{3}$ in head. Head width, $1\frac{4}{5}$ to $1\frac{7}{8}$ its length. Snout length, four-fifths its width, long as wide in young. Eye advanced, or hind pupil edge slightly before middle in head length; eye center about midway in head in young. Mouth small, jaws about even. Maxillary extends very little beyond nostril, slightly more so in young. Teeth in young, 36 in outer upper row and 30 in outer lower row, all well notched, and 2 to 4 inner inconspicuous rows of tridentate teeth. Adult teeth, 70 in each outer row and 6 to 8 inner irregular rows. Interorbital, convex. Rakers, 4+22, or about 3+10 in young, short, lanceolate; 4 in filaments, and latter equal eye. Scales, cycloid; basal striae about 13 in young, 16 to 18 in adult; circuli mos ly

complete. Cheek with 2 or 3 rows of scales. Scales on breast small, 25 to 27 before ventral origin to isthmus. Lateral line with simple tubes. Spinous dorsal edge notched; sixth spine, $2\frac{2}{3}$ to $2\frac{2}{3}$ in head. Soft dorsal and anal end in long points behind or about two-fifths in caudal; fifth dorsal ray, $1\frac{1}{3}$ to $1\frac{2}{3}$ in head; third anal spine, $2\frac{1}{3}$ to $2\frac{1}{3}$; fourth anal ray, $1\frac{1}{3}$ to $1\frac{3}{5}$. Caudal slightly emarginate behind. Pectoral with upper median rays longest to middle of soft anal base, 1 to $1\frac{1}{5}$ in head; ventral, $1\frac{1}{10}$ to $1\frac{1}{3}$. Ventral spine, half or less than fin length; long pointed first ray nearly to soft anal origin. Color in alcohol brownish, each scale with median small round pale spot. Pectoral uniform; other fins all more or less with small round pale spots, mostly terminal on ventral. Opercle with slaty-black blotch little less than eye. Eleven examples, 109 to 203 mm. Quanza River at Cunga.

TILAPIA HEUDELOTI A. Dumeril.

Head $2\frac{3}{5}$ to $3\frac{1}{10}$; depth, 2 to $2\frac{1}{3}$; D. XV or XVI, 10 to 14; A. III, 8 to 11; scales, 18 to 21 in upper section of lateral line, 9 to 15 in horizontal section to caudal base, and 2 or 3 more on latter; 2 or 3 scales above upper lateral line to soft dorsal origin and 6 to 8 below lower lateral line to spinous anal origin; 8 to 11 predorsal scales; snout, $2\frac{1}{4}$ to $3\frac{1}{2}$ in head; eye, $3\frac{1}{3}$ to 4; maxillary, $3\frac{1}{3}$ to 4; interorbital, $2\frac{1}{2}$ to $3\frac{1}{4}$. Body elongately ellipsoid. Least depth of caudal peduncle, $1\frac{2}{3}$ to $2\frac{1}{4}$ its width. Head width, $1\frac{7}{8}$ to $2\frac{1}{3}$ its length. Snout long as wide; length about four-fifths its width in young. Eye advanced; hind pupil edge about midway in head length in young; with age, front pupil edge about midway. Mouth small, lower jaw slightly included, sometimes slightly protrudes in young. Maxillary little beyond nostril in young, halfway beyond to eye with age. Outer teeth about 32 and lower 30 in young, all well notched, and 2 or 3 inner inconspicuous rows of tridentate teeth, well separated from outer rows. Adult teeth, 50 above and 25 below in outer row, all well notched, and 4 inner irregular rows of less conspicuous tridentate teeth in each jaw, well separated from outer row. Interorbital convex. Rakers, 4+10, short, lanceolate, half of filaments, or $1\frac{3}{4}$ in eye. Scales cycloid; basal striae, 11 to 14; circuli mostly complete. Cheek with 2 or 3 rows of scales. Scales on breast small, 24 to 26 before ventral origin to isthmus. Tubes in lateral line simple, or occasional small irregular accessory branch. Spinous dorsal edge notched; last spine, $1\frac{1}{2}$ to $2\frac{2}{3}$ in head. Soft dorsal and anal end in long points behind or about two-thirds in caudal, fifth dorsal ray, $1+1\frac{1}{4}$ to 2 in head; third anal spine, $2\frac{1}{3}$ to $2\frac{1}{2}$; fifth anal ray, $1+\frac{2}{7}$ to 2. Caudal slightly emarginate behind, $1+\frac{1}{3}$ to $1\frac{1}{3}$ in head. Pectoral with upper median rays longest, not quite to vent or within an eye-diameter of anal to anal in young; $1+\frac{1}{4}$ to $1\frac{1}{5}$ in

head; ventral, 1+¼ to 1½. Ventral spine, two-fifths of fin, which reaches far back as pectoral tips extend. Color in alcohol olive-brownish, generally largely uniform in adult; young with about 8 dark vertical bands. Blackish opercular blotch little less than eye-diameter. Black blotch about size of pupil at soft dorsal origin, larger and ocellate in young, and with 4 or 5 dark oblique streaks behind, much broader and fewer in young. Several dark bars on last anal rays in adult. Length, 49 to 225 mm.

The above account from 8 examples from the Quanza River, besides an adult from the St. Pauls River, in Liberia, and 26 examples from the Beyah River, at Elmina, in Ashantee, all previously listed.

TILAPIA CABRAE Boulenger.

Head, 2⅞; depth, 2 to 2⅛; D. XV, 12 or 13; A. III, 9 or 10; scales, 21 or 22 in upper section of lateral line, 10 to 13 in horizontal section to caudal base, and 2 to 4 more on latter; 2 or 3 scales above upper lateral line to soft dorsal origin, and 7 or 8 below from horizontal lateral line to spinous anal origin; 10 to 12 predorsal scales; snout, 2¾ to 3⅛ in head; eye, 3⅜ to 4; maxillary, 3⅛ to 3½; interorbital, 2⅜ to 2⅔. Body rather deeply ellipsoid, with predorsal usually somewhat prominent. Head width about half its length. Snout length about four-fifths to five-sixths its width. Eye advanced, or hind pupil edge slightly before middle in head length in young, scarcely median in larger examples. Mouth small; jaws about even. Maxillary extends slightly beyond nostril in young, or two-fifths in space beyond to eye in larger examples. Teeth in small examples, 36 in upper outer row and 40 in lower outer row, all well notched, and 3 or 4 inner rows of smaller tridentate teeth in each jaw. Adult teeth similar; outer in both jaws 50 and inner rows 7 or 8. Interorbital convex. Rakers, 4+13 or 14, short, lanceolate, 3 in filaments or 1⅜ in eye. Scales cycloid, basal striae 14 to 16, circuli mostly complete. Cheek with 3 or 4 rows of scales. Scales on breast small, 21 or 22 before ventral origin to isthmus. Lateral line with simple tubes. Spinous dorsal edge notched, last spine 1¾ to 1⅞ in head. Soft dorsal and anal end in long points two-fifths to one-half in caudal; fifth dorsal ray, 1⅛ to 1⅓ in head, third anal spine 2 to 2⅛, fourth anal ray 1⅛ to 1¼. Caudal convex behind, 1⅛ in head. Pectoral variably to vent, occasionally to anal; 1 1/10 to 1⅛ in head; ventral, 1 to 1 1/10. Ventral spine, 1⅜ to 1⅞ of fin and reaches further than pectoral, or at least to anal. Color in alcohol olive-brownish generally, largely uniform. Trunk with 5 or 6 inconspicuous dusky vertical bands, obsolete with age. Blackish opercular blotch less than eye. Dusky blotch at soft dorsal origin less than eye, less defined with age. Last dorsal and caudal rays with small round pale spots surrounded with deeper brownish. Five examples, 183 to 187 mm., from the Quanza River at Cunga.

HEMICHROMIS FASCIATUS Peters.

Seven examples from the Quanza River.

LAGOCEPHALUS LAEVIGATUS (Linnaeus).

One from Loando, 476 mm., compared with an example of equal size from Cape May, New Jersey, is indistinguishable. Also 2 smaller examples, 260 and 450 mm., same data. The lateral line seems variable in some cases and may appear broken or several times interrupted. Also 2 young in poor preservation, included previously under Sierra Leone, have 3-rooted conspicuous abdominal spines. Sides of body, especially below pectoral, with many large blackish round spots, nearly large as pupil. Back blue-black, sides and below bright silvery-white.

SPHEROIDES SPENGLERI (Bloch).

Upon comparison with a series of examples from Massachusetts, Florida, the Bahamas, and St. Martins, West Indies, my Loando example differs in coloration. In American material the caudal always shows a dark or black basal and terminal crossband, and though present in the Angola example, narrower and with the addition of a broad dark median bar. The black round spots on the side of the head and trunk below are fewer, only about 6 distinct as 4 before pectoral and 2 behind, though very pale traces of others exist. Several larger black blotches below eye and slightly backward do not occur in the American examples, though conspicuous in the Loando example. Evermann and Marsh [1] figure an inflated example of *S. spengleri* which differs from a nearly inflated Bahama example before me in the dark blotches being so far removed from the pectoral, as in all my material the seventh blotch is behind and scarcely at all below the pectoral base. The row is also continuous and not broken before the caudal peduncle in my material, and the upper 3 spots behind the pectoral, though present, are much higher.

ELEOTRIS VITTATA A. Duméril.

Head, $2\frac{2}{3}$ to 3; depth, 4 to $4\frac{4}{5}$; D. VI—I, 8, 1; A. I, 8, 1; scales 38 from shoulder to caudal base medially, and 8 more on latter; 17 scales transversely between soft dorsal and anal origins; 44 predorsal scales; snout, $4\frac{3}{4}$ in head; eye, $6\frac{1}{2}$; maxillary, $2\frac{3}{5}$; interorbital, 4. Body depressed in front, compressed behind. Head width, $1\frac{3}{4}$ its length. Caudal peduncle long, compressed; least depth, $1\frac{3}{5}$ its length and $3\frac{1}{8}$ in head. Snout wide, convex; length half its width. Eye well advanced: hind edge at first third in head measured from mandible tip. Maxillary nearly to hind pupil edge, greatly inclined;

[1] Bull U. S. Fish Comm., vol. 20, pt. 1, 1900, p. 267, fig. 79.

expansion, 1⅘ in eye. Teeth, fine, in rather broad bands. Mandible protrudes little in front. Tongue wide, smooth, free; front slightly emarginate. Front nostril midway in snout and hind one close over upper front eye edge. Interorbital depressed concavely. Preopercle with concealed spine directed down. Rakers about 4+6 rudimentary tubercles and filaments nearly equal eye. Scales on predorsal, about spinous dorsal base, head, breast, and belly, cycloid, circuli complete, and basal striae about 18. Scales on trunk largely ctenoid; basal striae about 32. Muzzle, most of mandible, cheeks in front and below, naked. First dorsal inserted about midway between front pupil edge and hind dorsal ray base, second spine 2½ in head. Soft dorsal inserted about midway between pectoral origin and middle of caudal peduncle length; seventh ray 2 in head, also seventh anal ray same. Caudal long, rounded, 1⅕ in head, pectoral 1½, ventral 2.

Color in alcohol deep warm brown, paler on under surfaces of head and abdomen. Deep brown streak from eye to shoulder, where widening as broad blackish band to upper basal part of caudal. Back and sides also mottled with deep brown. Two dark streaks back over cheek from lower hind eye edge and branchiostegal region mottled with dull umber, also muzzle. Iris brown. Fins all finely crossbarred with deep brown, coarser bands on spinous dorsal. One from the Quanza River, 165 mm.

MAPO SOPORATOR (Valenciennes).

Head, 3 to 3⅓; depth, 4⅓ to 4½; D. VI—I, 8, 1 or 9, 1; A. I, 8, 1; scales, 36 to 38 from shoulder to caudal base medially and 3 or 4 more on latter; 13 to 16 scales transversely between soft dorsal and anal origins; 26 to 33 predorsal scales; snout, 3¾ to 4⅕ in head; eye, 4½ to 5⅕; maxillary, 2¼ to 2⅓; interorbital, 6¾ to 8. Body moderately compressed. Caudal peduncle moderately long, well compressed; least depth about three-fourths to four-fifths its length, or 2⅕ to 2¼ in head. Head width, 1⅔ to 1½ its length. Snout rather broad, convex; length, two-thirds to three-fourths its width. Eye well advanced; center near first third in head length, which is more backward in smaller examples; impinging on upper profile. Maxillary to hind pupil edge in smaller example, to eye in larger. Jaws about equal. Teeth villiform, outer row enlarged, in narrow bands in jaws. Tongue thick, smooth, free, with slight median notch in front. Front nostril little nearer eye than snout tip and hind nostril close before eye. Interorbital concave. Rakers, six short, weak, inconspicuous rudimentary tubercles; filaments about half of eye. Scales crowded on predorsal, breast, and belly. Predorsal scales cycloid, with about 14 basal striae and circuli rather obsolete. Head naked, except occiput. Body scales ctenoid; circuli distinct and about 22 to 32

basal striae. First dorsal inserted little nearer snout tip than last dorsal ray base, or about midway between snout tip and sixth dorsal ray base; first spine, $1\frac{1}{2}$ to 2 in head. Soft dorsal inserted little nearer caudal base than eye, seventh or eighth rays, $1\frac{2}{3}$ to $2\frac{1}{3}$ in head. Anal opposite, similar. Caudal rounded; $1\frac{1}{3}$ to $1\frac{1}{4}$ in head; pectoral, $1\frac{1}{3}$ to $1\frac{2}{3}$; ventral, $1\frac{1}{2}$ to $1\frac{2}{3}$.

Color in alcohol uniform brown, paler or whitish on under surface of head and abdomen. About 5 broad darker crossbands and each row of scales with longitudinal dark streak. Head mottled brownish above and on sides. Dusky blotch size of pupil close behind eye, which brown. Dorsals and caudals finely crossbarred with darker; other fins brownish. Length, 85 to 125 mm.

One from the Quanza River at Cunga, and the others previously listed as 5 from the Elmina River in Ashantee and 1 from Mount Coffee in Liberia. An examination of scales of Florida and Bermuda examples shows them in complete agreement with the above.

10. Cape Town, Cape Colony.

Though the literature of South African ichthyology is quite extensive, most is recent. The first faunal work is contained in Sir Andrew Smith's account of the fishes in his Zoology of South Africa.[1] Later Bleeker [2] and Castelnau [3] described some species, Gunther a *Lophotes*,[4] and more recently numerous papers have appeared by Boulenger,[5] Gilchrist,[6] Gilchrist and Thompson,[7] and Thompson.[8] Five species were obtained by the Eclipse expedition.

LIZA RAMADA (Risso).

Head, $3\frac{3}{5}$; depth, 4; D. IV–I, 8; A. III, 9; scales, 44 from shoulder to caudal base medially and 4 more on latter; 14 scales between soft dorsal and anal origins; 32 predorsal scales; snout, $3\frac{1}{2}$ in head; eye, 6; maxillary, 4; interorbital, $2\frac{4}{5}$. Rakers about 40 + 60 fine, $1\frac{1}{3}$ in filaments and latter $1 + \frac{1}{8}$ eye-diameters. Preorbital edge rather

[1] Zool. S. A., Pisces, vol. 4, 1849, 31 pls. (letterpress not numbered).

[2] Nat. Tijds. Ned. Ind., vol. 31, 1860, pp. 49–80. Nat. Tijds. Dierk., vol 2, 1863, pp. 75–76, 250–269. Versl. K. Aks. Wet. Amsterdam, vol. 15, 1863, pp. 456–459.

[3] Compte Rendu Acad. Sci., Paris, vol. 1, 1860, 788–789.

[4] Proc. Zool. Soc. London, 1890, pp. 244–247, 2 pls.

[5] Marine Invest. S. Afric., vol. 1, 1898, pp. 1–4; vol. 2, 1900, No. 8, pp. 10–12, pl. 3, 13 pls.; vol. 1, 1902, pp. 1–4, 8–9; vol. 2, 1903, pp. 167–169, pls. Ann. S. Afric. Mus., vol. 1, 1899, pp. 379–380, pl.; vol. 2, 1901, pp. 227–228. Rep. Marine Biol., Cape G. Hope, 1898 (1899), pp. 196–197. Ann. Mag. Nat. London, ser. 7, vol. 9, 1902, pp. 335–336, fig.; ser. 7, vol. 14, 1904, pp. 16–20.

[6] Trans. S. Afric. Philos. Soc., vol. 10, 1899, p. VIII. Marine Invest. S. Afric., vol. 1, 1901 (1902), No. 6, pp. 97–179; vol. 2, 1902, pp. 101–113, 6 pls.; vol. 3, 1903, pp. 13–16, 18 pls., pp. 203–211, 10 pls.; vol. 4, 1908, pp. 43–171, 14 pls. Trans. Roy. Soc. S. Afric., vol. 3, 1913, pp. 33–35, fig. Marine Biol. Rep. Union S. Afric., No. 1, 1913, pp. 46–66.

[7] Ann. S. Afric. Mus., vol. 6, 1908, pp. 97–143, pp. 145–206, pp. 213–279; vol. 11, 1911, pp. 29–58, pp. 321–463, figs. S. Afric. Journ. Sci., vol. 7, 1911, pp. 214–224. Ann. Mag. Nat. London, ser. 7, vol. 8, 1911, pp. 477–478.

[8] Marine Biol. Rep. Prov. Cape of Good Hope, 1914, No. 2, pp. 132–167.

coarsely serrated. Alar flap in pectoral axil well developed. Pectoral, 1⅔ in head. First dorsal spine longest. Dull olive above, sides brassy, also lower surface. Length, 262 mm.

Compared with Mediterranean examples, 155 to 237 mm. long, the rakers were found shorter, very fine, and about long as the filaments, the latter equal to the eye. Their rakers are 50 to 72+66 to 90 on the right arch, and 50 to 72 + 65 to 96 on the left arch. The scales of the Mediterranean examples have 8 to 10 basal radii, while the African example has 12 to 14, a condition of age.

SCOMBER COLIAS Gmelin.

Head, 3⅓; depth, 5; D. VIII–II, 10+5; A. III, 9+5; snout, 3⅓ in head; eye, 4½; maxillary, 2½; interorbital, 3⅔. Body rather cylindrical, but slightly compressed. Head width half its length. Snout conic; width, 1⅓ its length; 1¼ in smaller example. Eye large, with broad adipose lid. Maxillary to pupil. Teeth minute, uniserial in jaws and on palatines. Few small teeth each side of vomer. Tongue sharp pointed, free. Front nostril simple pore about three-fourths of eye-diameter before eye, and hind nostril short slit close before eye. Interorbital convex, flattened medially. Rakers, 17+30, finely lanceolate, nearly long as eye, but slightly shorter than filaments. Scales small, largest behind pectoral base. Lateral line complete. Spinous dorsal midway between front nostril and soft dorsal origin; fin halfway to latter; second spine, 2⅓ in head; first branched dorsal ray, 5¼. Anal inserted slightly behind soft dorsal origin, similar. Caudal well forked. Pectoral reaches about halfway in depressed spinous dorsal, 2½ in head; ventral, 2⅓ and inserted about first fourth in pectoral. Air-bladder present. Color in alcohol olive-brown on back, marked with obscure darker oblique streaks, which appear as obscure dusky spots or blotches below lateral line along upper sides. Pectoral axil deep brown; other fins all pale. Length, 406 mm.

Evermann and Kendall have compared Atlantic and Pacific examples of the previously admitted cosmopolitan *Scomber japonicus* Houttuyn, pointing out that *S. colias* of the Atlantic is valid in its smaller head, more advanced spinous dorsal, etc.[1] My comparison of Atlantic examples from such remote places as New Jersey, Italy, and the present, do not exhibit characters of specific value. The New Jersey and Italian examples have 12 to 15+25 to 30 rakers.

TRACHURUS SEMISPINOSUS (Nilsson).

Head, 3⅔; depth, 4; D. VIII—I, 32; A. II—I, 27; scutes, 36+38; snout, 3⅔ in head from upper jaw tip; eye, 3⅚; maxillary, 2⅔; interorbital, 3½. Body well compressed, fusiform, deepest at spinous

[1] Proc. U. S. Nat. Mus., 1911, p. 38.

dorsal. Head pointed, lower profile more inclined. Snout long as broad. Eye large, adipose eyelids wide, hind pupil edge midway in head length. Maxillary to pupil. Lower jaw protrudes. Teeth minute, simple, uniserial in jaws. Row of similar teeth on palatines and small patch on vomer. Tongue pointed, free. Nostrils together, nearly width of pupil before upper front eye edge. Interorbital convex. Rakers about 18+48, lanceolate, slender, equal filaments or about 1¼ in eye. Pseudobranchiae about three-fifths of gill-filaments. Scales small, scutes in lower straight section of lateral line broader. Spinous dorsal origin about midway between front eye edge and soft anal origin in vertical, third spine longest. Soft dorsal inserted nearly midway between front nostril and caudal base, front rays little elevated. Soft anal similar, inserted about midway between hind eye edge and caudal base. Caudal (tips damaged) about 1⅔ in head. Pectoral not quite to soft anal origin. Ventral close behind pectoral base, three-fourths to spinous anal and vent close before latter. Color in alcohol uniform brownish, paler below, and body largely with brassy reflections. Black opercular spot little smaller then pupil. Pectoral axil black. Other fins all pale brownish. Dorsal tip and outer portions of soft dorsal and anal each with dark brownish tinge. Length, 331 mm.

Though I have no European examples for comparison, the above seems to agree with Nilsson's account,[1] he giving but 75 scutes, of which were 38 spiny.

POMATOMUS SALTATRIX (Linnaeus).

Head, 3⅔; depth, 3⅔; D. VIII—II, 25; A. II, 28; scales in latera line (damaged) 85 (?) to caudal base and 6 more on latter, 9 above, and 16 below; snout, 3⅓ in head, measured from upper jaw tip; eye, 6; maxillary, 2 1/10; interorbital, 3½. Rakers, 3+8, three-fourths of filaments, and latter 1⅙ in eye. Pectoral, 1¾ in entire head length. Brown blotch at pectoral base. Length, 396 mm.

I have no examples over a foot in length for comparison, and these from Massachusetts, New Jersey, and Rio Janeiro. They all show but 11 developed rakers on the lower arch, the formula so far examined always 3+11. The scales show no differences except characters of age. The American examples have but few scale denticles, and usually with the numerous circuli unbroken, likely due to their adolescence. The Cape example has strongly denticulated scales and several basal striae.

DENTEX ARGYROZONA Valenciennes.

Head, 2⅞; depth, 2⅔; D. XII, 10, 1; A. III, 8; scales, 56 in lateral line to caudal base and about 7 more on latter; 7 scales above lateral

[1] Prodr. Ich. Scand., 1832, p. 38. In sinu. Codano & Mari Norvegica.

line and 15 below; about 60 predorsal scales; snout, $3\frac{1}{10}$ in head; eye, $4\frac{2}{5}$; maxillary, $2\frac{2}{5}$; interorbital, $3\frac{3}{4}$.

Body well compressed, contour elongately ellipsoid. Caudal peduncle compressed, least depth $1\frac{2}{3}$ its length. Head elongately triangular, upper profile slightly more inclined, well compressed with flattened sides but slightly constricted below. Snout convex, slightly so in profile and width about $1\frac{1}{8}$ its length. Eye large, little elevated, advanced so hind pupil edge about midway in head length. Maxillary to pupil, expansion slightly less than half of eye. Teeth uniserial. Two large curved canines in front of each jaw and front pair of smaller ones in upper. Upper teeth smaller than lower, less developed, and largely concealed in coriaceous lips. Vomer and palatines entire. Tongue depressed, pointed, little free. Nostrils close together, little before eye. Interorbital convex. Greatest preorbital width equals eye. Preopercle edge entire. Rakers about 10+17, three-fifths of filaments, which $1\frac{2}{3}$ in eye. Scales finely ctenoid, largely uniform, though smaller on top of head, caudal base, and sheaths along bases of vertical fins. Cheek with 8 rows of scales. Axillary ventral scaly flap $2\frac{1}{2}$ in fin. Lateral line of simple tubes. Dorsal origin slightly behind pectoral origin; spines slender, fourth spine, $2\frac{2}{3}$ in head. Soft dorsal origin about midway between bases of caudal and fourth dorsal spine, rays sloping down behind and first $3\frac{2}{3}$ in head. Spinous anal inserted about opposite soft dorsal origin; second spine 4 in head, though third (damaged) longest. Soft anal like soft dorsal. Caudal well emarginate behind; upper lobe $1\frac{1}{2}$ in head. Pectoral nearly to vent, which close before vent, $1\frac{1}{3}$ in head; ventral, 2.

Color in alcohol uniform brownish generally, silvered and brassy reflections on sides below, which region also generally paler. Iris, brown. Fins, dull brown. Length, 293 mm.

DESCRIPTIONS OF NEW SPECIES OF MOLLUSCA FROM THE NORTH PACIFIC OCEAN IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM.

By William Healey Dall,
Honorary Curator of Mollusks, United States National Museum.

INTRODUCTION.

In preparing a census of the shell-bearing Marine Mollusca of the west coast of North America from the Arctic Sea to San Diego, California, with the view of compiling a classified checklist of these animals, it became necessary to review the entire fauna of the west coast of both Americas, as it proved that the range of many species is far greater than had hitherto been assumed. The National Collection is probably the richest in the world for the region indicated, including the dredgings of the United States Bureau of Fisheries steamer *Albatross*, as well as the contributions of a multitude of collectors during nearly half a century. The presence of the types of species described by Gould, Carpenter, and Stearns among the earlier collectors has facilitated the accurate determination of many more or less obscure forms. Among the species examined, especially those from warmer waters and from depths not reached by private collectors, there were found many which seemed to be undescribed.

In order to avoid the publication in the checklist of manuscript names or the omission of species needed for completeness, it has seemed best to prepare diagnoses of such forms as appear clearly new. This has already been done in another publication for the group of Chitons and for the family of Turritidae (formerly known as the Pleurotomidae) and the latter difficult group fully illustrated. It is hoped that the other unfigured species may be illustrated later, but under present conditions the best that could be done was the preparation of full and exact diagnoses and measurements. The types of these new species are, with hardly an exception, preserved in the National Collection.

A thorough and exhaustive collection of the mollusca of the Panamic fauna is still a desideratum and can hardly fail, when made, to enormously increase the number of species known, especially among the minute forms. There are particular areas like the Gulf of Dulce in Central America and the St. Elena region on the north-

western coast of South America which promise rich returns to the explorer. From the latter region Cuming many years ago obtained material which kept the British naturalists, Broderip, Sowerby, and Reeve busy for a score of years describing and illustrating his harvest of new forms. And yet Cuming seems to have collected very few of the smaller species.

From California northward more exhaustive work has been done, though there are notable gaps, many miles in extent, where dredging has never been attempted and shore collections are practically unknown. The character of the coast does not, in such regions, lend itself to easy investigation. Nevertheless we may consider the general fauna as fairly well known, though still affording the prospect of many novelties.

If we regard that region where a given genus is represented by the greatest number of specific forms as being probably the center of origin for species of that group, the conclusion is quite obvious that the Oregonian fauna taken in its widest sense is the parental source of the greater part of the boreal mollusks of the world. On the other hand, if the meager fauna of the boreal Atlantic be taken as the focus of origin, the reverse would be true, and the differentiation of specific forms be greatest at the most distant area of migration, other things being equal.

The Tertiary faunas present much the same problem when analyzed, but in some instances suggest the possibility of reciprocal migration; particular types appearing later in America than in Europe, and the opposite. There can be no doubt, however, that migration of species in the boreal region between the two hemispheres was more easy and the routes more open in the Pliocene and ate Miocene than at any subse quent period. In the tropical region, however, the reverse appears to be true, intercommunication between the two oceans having been finally interrupted at the end of the Oligocene period. In my report on the collections of the *Albatross* in the Panamic region I have called attention to the remarkable differences which have resulted from this cause in the composition of the Caribbean and Panamic mollusk faunas.

The explorations of the *Albatross* in the Okhotsk Sea and on the coasts of northern Japan and eastern Siberia, taken with those of the Canadian Arctic Expedition and others on the American side, have cleared up many obscurities in our conception of the geographical distribution of boreal mollusks. We know now that the Asiatic fauna, even near Bering Strait, notwithstanding its geographical approximation is measurably distinct from that of the American coasts, and that the latter on the Arctic shores extends without Greenlandic admixtures far to the eastward of the Mackenzie River delta. Of course there is the expected admixture of characteristically

polar forms at the west and a few species of the Oregonian fauna reach both coasts of the Pacific, but only sufficient to contrast with the body of the Asiatic fauna.

In the present paper the locality of the type specimen under description and the number of the type in the Museum Register is given; the entire range covered by the species as far as now known will appear in the Checklist when issued. The manuscript of the latter is ready for the printer and together with the already published Checklist of the bivalves will cover all the marine mollusca of the region specified except the Nudibranchs and Cephalopods which are referred to specialists.

The number of new forms described in the present paper is 222, of which 26 are from the region of the Gulf of California, 4 from the Panamic region, 9 from the Galapagos Islands, 18 from Japan and the adjacent Asiatic coast, and the remainder from San Diego, northward on the American coast to the Arctic Sea. Only the latter group will be included in the checklist, the others being extralimital.

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DESCRIPTIONS OF THE SPECIES.

ACTEOCINA SMIRNA, new species.

Shell minute, white, with yellowish periostracum, of about four whorls with a very minute subglobular hardly projecting glossy nucleus; summit of spire with the whorl but little raised, flattish but not excavated between the suture and the bluntly rounded shoulder; shell in front of the shoulder subcylindric, with fine axial incremental lines; aperture narrow, outer lip thin, nearly straight, rounding in front into the rather wide, slightly excavated pillar which near the body carries a single strong plait; body with a thin coat of enamel, the umbilical region slightly impressed but imperforate; length, 4; diameter, 2 mm. U. S. Nat. Mus. Cat. No. 271492.

Type-locality.—San Diego, California, C. R. Orcutt. The range of this species extends southward to San Salvador.

ACTEOCINA MAGDALENENSIS, new species.

Shell small, slender, subcylindric, translucent white, polished, with four whorls, the nucleus minute, subglobular, transparent; suture distinct, more or less channeled, spire short but distinctly turrited aperture narrow, outer lip straight, rounding below into the thickened

pillar which has a strong plait with a groove behind it, the body with a slight glaze; length, 6.7; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 218410.

Type-locality.—Magdalena Bay, Lower California, collected by C. R. Orcutt.

RETUSA XYSTRUM, new species.

Shell minute, white, subcylindric, the aperture as long as the shell, the whorls involved, with a deep pit at the apex, slightly wider in front; very little constricted around the middle; sculpture of extremely fine close longitudinal grooves covering the whole surface; the base produced, imperforate; the aperture very narrow, outer lip straight, as long as the shell, simple, sharp, rounding into the base; length of the shell, 3; maximum diameter, 1 mm. U. S. Nat. Mus. Cat. No. 273985.

Type-locality.—Dredged at San Diego, California, by C. R. Orcutt. Also found at San Pedro.

RETUSA BAZIANA, new species.

Shell minute, white, with an involved spire, above which is a rather large perforation; the general form is subcylindric, wider anteriorly, obscurely widely constricted about the middle of the shell, rounded at the summit, the aperture as long as the shell; sculpture wholly axial, of fine, sharp, close vertical grooving extending over the whole shell, with no perceptible spiral sculpture; aperture very narrow except at the base, rising somewhat above the summit of the shell; base rounded, pillar simple with no chink behind it; height, 3; maximum diameter, 1.4 mm. U. S. Nat. Mus. Cat. No. 211418.

Type-locality.—U. S. Fish Commission station 2823, off La Paz, Gulf of California, in 26 fathoms broken shell.

RETUSA GALAPAGANA, new species.

Shell minute, white, involved, with a deep pit at the apex, the aperture as long as the shell; form subcylindric, the diameter slightly larger anteriorly, the middle of the whorl feebly constricted, the whorl at the summit rounded; the entire shell axially closely sharply grooved; outer lip thin, sharp, aperture very narrow behind the base, pillar simple, rounding into the basal lip; height of shell, 3; maximum diameter, 1.5 mm. U. S. Nat. Mus. Cat. No. 194976*b*.

Type-locality.—U. S. Fish Commission station 2813, at the Galapagos Islands, in 40 fathoms, coral sand; temperature at surface, 81° F.

VOLVULELLA COOPERI, new species.

Shell subcylindric, white, in the young with a very short spine, the adult having the spine obsolete or even absent, involved, bluntly rounded at each extremity, the aperture as long as the shell; surface

entirely smooth; aperture parallel with the body, very narrow, body with no perceptible enamel, pillar very short, thickened, slightly reflected with a minute chink behind it; length of shell, 9.5; diameter, 3.6 mm. U. S. Nat. Mus. Cat. No. 105501.

Type-locality.—Scammon Lagoon, Lower California, collected by Henry Hemphill. Its range extends north to San Pedro, California.

This is larger, smoother, and less distinctly spinose in the adult than any other west coast species.

VOLVULELLA CALIFORNICA, new species.

Shell minute, polished, white, elongate-ovate, involved, with a short apical spine; axial sculpture of very faint incremental lines; spiral sculpture of microscopic striae near the anterior end; axis imperforate; aperture as long as the shell, outer lip reaching to the end of the spine, from which it is separated by a narrow groove, laterally straight, anteriorly rounding to the slightly thickened pillar; body with a coat of enamel which extends to the pillar and the spine; length, 4; diameter, 1.7 mm. U. S. Nat. Mus. Cat. No. 211303.

Type-locality.—U. S. Fish Commission station 2902, off Santa Rosa Island, California, in 53 fathoms sandy mud: the bottom temperature, 45° F.

VOLVULELLA PANAMICA, new species.

Shell small, involved, ivory white, smooth except for very faint incremental lines, apex with a small short sharp spine extending beyond the edge of the outer lip; form subcylindric, aperture very narrow with a deep apical sulcus, base rounded, pillar very short with a slight twist; length of shell, 4.25; diameter, 1.75 mm. U. S. Nat. Mus. Cat. No. 212654.

Type-locality.—Panama Bay at station 2799, in 29½ fathoms, U. S. Fish Commission.

VOLVULELLA CATHARIA, new species.

Shell small, plump, ovate, ivory white, involved, with a hardly perceptible point at the apex; surface polished; aperture almost or quite equal in length to the shell, narrow, wider in front, the outer lip nearly straight laterally; near the apex and at the pillar the enamel on the body is slightly reflected with a free edge; there are a few hardly perceptible spiral striae, with wider interspaces, near the anterior end; the shell, for so small a species, is relatively thick; length of shell, 2.75; diameter, 1.8 mm. U. S. Nat. Mus. Cat. No. 211784.

Type-locality.—U. S. Fish Commission station 2794, in Panama Bay, in 62 fathoms, sand; bottom temperature, 60° F.

VOLVULELLA CALLICERA, new species.

Shell minute, involved, white, with a short spine at the apex, subcylindrical, almost equally attenuated at both ends, smooth and polished, the outer lip slightly falling short of the end of the spine, laterally straight, rounding gently into the pillar lip in front; aperture not quite as long as the shell, the body polished, a slight thickening on the pillar lip; length, 3.5; diameter, 1 mm. U. S. Nat. Mus. Cat. No. 194976*b*.

Type-locality.—U. S. Fish Commission station 2813, off the Galapagos Islands, in 40 fathoms, coral sand.

SCAPHANDER WILLETTI, new species.

Shell small, yellowish white, of about four whorls, the apex sunken but exposed in a pit bounded by a sharp carina, the shell wider anteriorly; surface with faint incremental lines crossed obliquely by minute vermicular sculpture, which is more nearly spiral about the middle of the shell and visible only under a lens; aperture narrow behind, wider and produced in front, the edge of the outer lip produced to form the apical carina, laterally straight and rounded to the pillar in front; umbilical region covered with a smooth layer of enamel, pillar concave, axis twisted; height of shell, 12.5; maximum diameter, 7; diameter at apex, 2 mm. U. S. Nat. Mus. Cat. No. 216405.

Type-locality.—Forrester Island, Alaska; George Willett.

DIAPHANA BRUNNEA, new species.

Shell small, reddish brown, thin, with a small subglobular nucleus and about three whorls, separated on the flattish summit by a rather deep suture; the last whorl rather large, swollen, widest in front; surface smooth; aperture not quite as long as the shell, narrow behind, expanded in front; outer lip thin, nearly straight, rounding into the pillar lip which is reflected over but does not close a narrow umbilical chink; inner lip thinly glazed, the axis not gyrate; height of shell, 5; diameter, 3.5 mm. U. S. Nat. Mus. Cat. No. 208718.

Type-locality.—Harbor of St. Paul, Kodiak, Alaska; in 15 to 20 fathoms, gravelly bottom. Collected by W. H. Dall.

DIAPHANA CALIFORNICA, new species.

Shell translucent and whitish, thin, the brown soft parts showing through, subcylindric, the nucleus minute, globular, with about three subsequent whorls; the spire blunt with the whorls rounded narrowly above a deep suture; surface smooth except for faint incremental lines, polished; aperture as long as the shell, posterior sulcus small, outer lip thin, sharp, straight, axis imperforate, pillar lip thin, body hardly glazed; height, 4.5; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 130561.

Type-locality.—Long Beach, California; collected by Miss Shepard, now Mrs. Oldroyd.

CYLICHNELLA (BULLINELLA) DIEGENSIS, new species.

Shell small, thin, cylindric, white, with a pale straw-colored periostracum with reddish brown spiral lines on the base and near the apex; whorls involved, the apex exhibiting a funicular depression ending in a minute perforation; the surface smooth and polished except for faint incremental lines; aperture very narrow, the outer lip thin, straight, recurving deeply around the apex, at the base receding and rounding into the simple, thickened pillar lip; body with a slight glaze; length of shell, 8; diameter, 3.5 mm. U. S. Nat. Mus. Cat. No. 209071.

Type-locality.—U. S. Fish Commission station 4359, off Point Loma, San Diego County, California, in 98 to 191 fathoms, muddy bottom.

BULLARIA QUOYANA, new name.

This is *Bulla quoyi* A. Adams, 1850, but not of Gray, 1843. The species ranges from Catalina Island, California, to Acapulco, Mexico.

HAMINOEA OLGAE, new species.

Shell large, thin, very light yellowish green or reddish brown, inflated, with the outer lip rising high above the sunken and impervious spire; the apical depression not carinate, the axis gyrate and widely pervious; outer lip arcuate, thin, sharp, rounding into the pillar below; axial sculpture confined to low narrow irregular wrinkles, stronger distally; spiral sculpture of minute, close-set, slightly wavy striae over the whole surface; the inner lip with a thin coating of whitish enamel; height of shell, 27; diameter, 16 mm. U. S. Nat. Mus. Cat. No. 216812.

Type-locality.—Sandspit, Peavine Pass, Olga, Washington, collected by C. C. Engberg. The species ranges to Lower California, at San Quentin Bay.

The nearest relative of this species is *H. vesicula* Gould, which is uniformly smaller, paler, with a shorter body and wider axial gyration.

PHILINE BAKERI, new species.

Shell minute, translucent, of two or more whorls, enfolded, except the subglobular nucleus by the last whorl; apex blunt; last whorl narrow, obliquely expanded in front; sculpture of numerous fine incised punctate spiral lines with wider interspaces; axis gyrate, pervious; aperture as long as the shell, narrow behind with a very slight sulcus, but widely expanded in front; outer lip thin, sharp, straight, inner lip hardly glazed; height, 2; diameter, 1.25 mm. U. S. Nat. Mus. Cat. No. 225194.

Type-locality.—Off the South Coronado Island in 3 to 6 fathoms; collected by Dr. Fred Baker.

PHILINE HEMPHILLI, new species.

Shell small, greenish-white, thin, of about three whorls, the last enveloping the others, the axis gyrate, widely pervious; apex depressed, not perforate, bluntly rounded; aperture as long as the shell; surface smooth, except for a few microscopic spirals near the summit and faint incremental lines; outer lip thin, a deep sulcus between it and the spire; the middle part of the lip much produced, the anterior part receding and curving roundly into the thin pillar lip, the body hardly glazed; height, 5; diameter, 3 mm. U. S. Nat. Mus. Cat. No. 211753.

Type-locality.—U. S. Fish Commission station 2936, off Cape San Quentin, Lower California, in 359 fathoms; bottom temperature, 49° F.

CRYPTOGEMMA EIDOLA, new species.

Shell small, white, covered with an olivaceous periostracum, and with four whorls exclusive of an apical whorl or two (which in the specimens is always eroded), suture distinct, the edge of the whorl in front of it slightly thickened; spiral sculpture on the upper whorls of a somewhat blunt peripheral keel, undulated more or less toward the apex and obsolete on the last whorl; other sculpture of minute, broken, irregular, more or less oblique, usually punctate impressed lines; aperture simple, the outer lip sharp, the body erased, white, the canal short, somewhat recurved; height of four whorls, 15; of last whorl, 10; diameter, 7 mm. U. S. Nat. Mus. Cat. No. 212336*a*.

Type-locality.—Off San Diego, California, in 822 fathoms, mud; U. S. Fish Commission.

CRYPTOGEMMA OREGONENSIS, new species.

Shell small, white, with a pale olivaceous periostracum, and more than four whorls, the apex always eroded, the suture distinct, the whorl in front of the suture as far as the shoulder flattish; shoulder of the whorl strongly marked, angular, coronated by the ends of (on the penultimate whorl about 25) straight, protractively oblique narrow ribs with subequal interspaces, becoming obsolete on the base of the last whorl; incremental lines more or less distinct but not regular; spiral sculpture of one or two feeble impressed lines on the whorl above the shoulder, and three or four widely spaced threads on the base, though the region of the canal is free from spiral sculpture; aperture narrow, anal sulcus wide and shallow, outer lip produced, thin, body and pillar erased, canal rather short, axis pervious; height of four whorls 11; of last whorl, 7; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 214243.

Type-locality.—U. S. Fish Commission station 3346, off Tillamook Bay, Oregon, in 786 fathoms, ooze; bottom temperature, 37.3° F.

BORSONELLA CIVITELLA, new species.

Shell fusiform, elongate, acute, of a pale buff color, of eight or more whorls, the nucleus defective, the suture distinct, not appressed; axial sculpture of (on the penultimate whorl, 9) short prominent ribs conspicuous only on the periphery and obsolete on the later part of the last whorl, the incremental lines are also rather conspicuous; there is no spiral sculpture except a few faint lines on the anal fasciole which is adjacent to the suture; in addition to the above there are minute oblique striae often punctate, with wider interspaces which cross the incremental lines almost at right angles; these, hardly visible except under a lens, give the surface a vermiculate aspect; aperture rather narrow, the anal sulcus wide and shallow, the outer lip strongly protractively arcuate, thin, simple; inner lip with a thin wash of callus, pillar straight with a single plait, throat yellowish, canal wide, straight; height of shell, 19; of last whorl, 11.5; of aperture, 8; diameter, 6.5 mm. U. S. Nat. Mus. Cat. No. 209034.

Type-locality.—U. S. Fish Commission station 4310, off Point Loma, California, in 71 to 75 fathoms sandy mud.

The plait on the pillar is invisible from the aperture.

LORA FIORA, new species.

Shell small, grayish white, acute, with a small subglobular nucleus and six subsequent whorls moderately rounded and with a slight shoulder; suture distinct, not appressed; spiral sculpture of (on the penultimate whorl in front of the shoulder about 6) incised lines, with wider interspaces, overrunning the ribs; on the last whorl this sculpture extends to the canal; axial sculpture of (on the last whorl about 17) short rounded ribs extending from the shoulder, where they are most prominent, over the periphery and obsolete on the base; there are also fairly distinct incremental lines; aperture short, wide, with a feeble anal sulcus and hardly differentiated canal; outer lip thin, simple, inner lip erased; throat whitish; height of shell, 9.75; of last whorl, 6; of aperture, 4; diameter, 4 mm. U. S. Nat. Mus. Cat. No. 220399*a*.

Type-locality.—Adakh Island, Aleutians, in 15 fathoms, mud and sand; collected by W. H. Dall.

LORA CASENTINA, new species.

Shell small, white, with about five whorls, the nucleus decorticated, the whorls with a subangular shoulder in front of the anal fasciole; axial sculpture of (on the penultimate whorl about 20)

low, thread-like ribs extending from the shoulder to the succeeding suture, but more or less obsolete on the last whorl; spiral sculpture of faint feeble striae on the fasciole, in front of the shoulder of numerous close-set flattish small threads, extending uniformly to the canal; anal sulcus shallow; outer lip slightly arcuate, inner lip erased; pillar short, straight; canal hardly differentiated; height of shell, 9; of last whorl, 7; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 209257.

Type-locality.—U. S. Fish Commission station 4538, off Point Pinos Light, Monterey Bay, California, in 795 to 871 fathoms, sand.

LORA GALGANA, new species.

Shell white, under a yellowish periostracum, of six or more obtusely shouldered whorls, the apex decorticated, the suture appressed; axial sculpture on the earlier whorls of about 18 protractively oblique rounded ribs, slightly angulate at the shoulder, feeble on the fasciole and crossing the whorls except on the last whorl where they gradually become obsolete; the whole surface is spirally sculptured with fine close-set threads, here and there one a little more prominent than the rest, others near the canal coarser; anal sulcus wide and shallow; outer lip arcuate, inner lip erased; canal moderately long, slightly recurved; height of shell, 15; of last whorl, 11; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 214173.

Type-locality.—U. S. Fish Commission station 3330, Bering Sea, north of Unalaska in 351 fathoms, sand.

LORA AMIATA, new species.

Shell elevated, rugose, white under a pale yellow periostracum, with six subtabulate whorls, the nucleus decorticated, suture obscure, closely appressed; spiral sculpture of an angle at the shoulder, between which and the suture are four or five close-set small equal threads; in front of the shoulder is a constriction beyond which are about a dozen deep grooves with wider rounded interspaces which are finely spirally striated; on the canal there are crowded small threads; axial sculpture of about 15 short ribs extending from the shoulder, which they nodulate, to the periphery only; aperture narrow with a shallow anal sulcus; outer lip thin, inner lip erased, canal straight and short; height of shell, 15; of last whorl, 10.5; of aperture, 8; diameter, 7 mm. U. S. Nat. Mus. Cat. No. 214219.

Type-locality.—Off Belkoffski, Alaska, in 15 to 75 fathoms, shelly bottom; collected by W. H. Dall.

LORA RASSINA, new species.

Shell small, white, with a small (decorticated) nuclear whorl and five subsequent slightly shouldered whorls; suture distinct, not

appressed; axial sculpture of (on the last whorl about 20) narrow rounded ribs extending from the suture over the periphery but more or less obsolete on the base; the interspaces wider; spiral sculpture of numerous close-set rounded threads over the whole surface but not nodulating the ribs; anal sulcus very shallow, outer lip thin, nearly straight, inner lip erased, canal very short, hardly differentiated from the aperture; height of shell, 10; of last whorl, 7; diameter, 5.5 mm. U. S. Nat. Mus. Cat. No. 214224.

Type-locality.—U. S. Fish Commission station 3305, in Bering Sea, southwest of Hagmeister Island in 23 fathoms, mud; bottom temperature, 41.8° F.

PHILBERTIA CAPANIOLA, new species.

Shell small, strongly sculptured, yellowish white, elevated, with about six whorls, including the smooth minute nucleus of about one whorl; suture distinct, rather deep, whorls well rounded; axial sculpture of (on the last whorl 11, omitting the final varix) narrow rounded ribs with a slight shoulder, extending to the canal, with wider interspaces, both crossed by the spirals but without nodulation; spiral sculpture of (on the spire in front of the shoulder about 4) well-defined cords with narrower interspaces, which become more or less obsolete on the last whorl; aperture narrow, the anal sulcus shallow, and producing no very marked fasciole; outer lip infolded, thick, with a varical swelling behind it, simple within; body erased, pillar short, straight; canal hardly differentiated; height of shell, 6.5; of last whorl, 4; of aperture, 3.5; diameter, 3 mm. U. S. Nat. Mus. Cat. No. 150992*a*.

Type-locality.—Near San Diego, southeast of Point Loma, in 12 to 15 fathoms; collected by Dr. Fred Baker.

MANGILIA (KURTZIELLA) ALESIDOTA, new species.

Shell small, yellowish, with on the last whorl a faint dark band in front of the suture and an obscure dark line at the periphery, with a dark flush on the canal; with six whorls, including a minute smooth nucleus followed by a minutely reticulated second whorl, and then by the adult sculpture; suture distinct, slightly appressed, the anal fasciole occupying the space between it and an angular shoulder; axial sculpture of (on the penultimate whorl, 15) narrow, sharp, arcuate ribs extending from the suture over the periphery, with wider interspaces; there are also minute incremental lines roughening the spirals; spiral sculpture of numerous minutely channeled grooves with wider flattish interspaces (the latter sometimes with a smaller median groove) covering the whole surface; aperture narrow, with a wide very shallow anal sulcus; outer lip thin, sharp, body erased, pillar straight, axis pervious, gyrate; canal hardly differentiated;

height of shell, 7.5; of last whorl, 5.2; of aperture, 3.5; diameter, 3 mm. U. S. Nat. Mus. Cat. No. 56913.

Type-locality.—Catalina Island, California; W. H. Dall.

MANGILIA (KURTZIELLA) TERSA, new species.

Shell small, thin, slender, acute, yellowish with a narrow peripheral brown band, which on the spire lies just behind the suture; with seven and a half whorls, including the polished nucleus, which begins with a small coil then becomes more inflated and finally presents a peripheral keel before the normal adult sculpture begins; axial sculpture of (on the last whorl about 13) narrow rounded ribs with much wider interspaces, extending over the base on the last whorl and most prominent at the periphery on the spire; there are also fine incremental lines which in unworn specimens make the sculpture minutely imbricated; suture distinct, appressed, and more or less undulated by the ribs; anal fasciole wide, constricted, forming a slight shoulder to the whorl in front of it; spiral sculpture of fine close scabrous revolving threads over the whole surface; aperture narrow, outer lip thin, simple, with a wide shallow anal sulcus, the body erased, the pillar straight, attenuated in front, canal short, hardly differentiated; height of shell, 11; of last whorl, 6.5; of aperture, 5; diameter, 3.5 mm. U. S. Nat. Mus. Cat. No. 133910.

Type-locality.—San Diego, California; Miss J. M. Cooke.

AGATHOTOMA POMARA, new species.

Shell small, fusiform, solid, with six moderately convex whorls, the nucleus small, subglobular, smooth (slightly decorticated); axial sculpture of (on the penultimate whorl 11, on the last whorl 9) prominent, slightly shouldered ribs with wider interspaces, the ribs undulating the appressed suture; spiral sculpture of close-set alternated threads over the whole surface except between the shoulder and the suture, which is arcuately striated by the incremental lines; aperture narrow, straight, the anal sulcus moderate, the outer lip thickened, simple, the inner lip with a wash of enamel; the canal hardly differentiated; height of shell, 7; of aperture, 4; diameter, 3 mm. U. S. Nat. Mus. Cat. No. 152746.

Type-locality.—San Pedro, California; H. Lowe.

The shell is discolored so the normal color can not be determined.

ZETEKIA CURTA, new species.

Shell, small, short, solid, inflated, of a brownish color, nucleus minute smooth, succeeded by about three subsequent strongly sculptured whorls; suture distinct; axial sculpture of (on the penultimate whorl about 15) narrow, sharp, similar riblets with wider interspaces, this sculpture extending over the base; spiral sculpture of (on the

last whorl about 16) even regular similar threads with subequal interspaces which pass over but do not nodulate the ribs; aperture narrow, outer lip thickened, crenulate by the sculpture, not reflected; anal sulcus shallow but conspicuous; pillar lip smooth, the pillar with a layer of enamel with a raised edge, canal short, deep, but hardly differentiated. Height 2.3; diameter 1.5 mm. U. S. Nat. Mus. Cat. No. 214266.

Type-locality.—Panama Bay in 29 fathoms, U. S. Bureau of Fisheries, Station 2799.

Genus CANCELLARIA Lamarck, 1799.

After a careful examination of the literature, including the arrangement by Dr. Jousseaume, I have come to the conclusion that the Californian species of the genus *Cancellaria* in its wider sense can not properly be included in any of the groups into which it has been hitherto divided. I have therefore proposed[1] for them the subgeneric name of *Progabbia* in honor of William M. Gabb, an indefatigable worker in recent and fossil Conchology and one of the earliest paleontologists on the west coast. The type is *Cancellaria cooperi* Gabb, one of the finest and probably the largest species of *Cancellaria* living. The hirsute species like *C. crawfordiana* Dall may be regarded as forming a section *Crawfordina*.

ADMETE RHYSSA, new species.

Shell small, white, with an olivaceous periostracum, a loosely coiled (decorticated) nucleus, and about four subsequent whorls separated by a distinct suture; axial sculpture of (on the last whorl a dozen) rather narrow, nearly vertical ribs, which extend from suture to suture on the spire and from the suture to the margin of the base in the last whorl, with wider interspaces; incremental lines rather marked; spiral sculpture of (on the spire four, on the last whorl eight) prominent threads with wider interspaces, overriding the ribs and coming to a node when they intersect them; the base nearly smooth except for one or two minor threads near the canal; aperture semilunate, the outer lip thin, body with a thin layer of enamel; pillar with three oblique plaits, canal shallow, short, with a faint fasciole; height of shell, 7; of last whorl, 5; diameter, 4.5 mm. U. S. Nat. Mus. Cat. No. 211241.

Type-locality.—U. S. Bureau of Fisheries station 4343, off the South Coronado Island, in 155 fathoms, sandy bottom.

MARGINELLA ALBUMINOSA, new species.

Shell large, creamy white, thin for its size, brilliantly polished, with a translucent yellowish depressed nucleus of two whorls and

[1] Proc. Biol. Soc. Wash., vol. 31, p. 138, Nov. 29, 1918.

three subsequent whorls; spire low, covered with a thin coating of enamel which partly obscures the sutures; last whorl plump, with a tinge of yellow outside the varix and around the siphonal fasciole; outer lip with a narrow external thickening, internally quite smooth; inner lip with four prominent thin plaits with wider interspaces, counting the elevated edge of the pillar; height of shell, 27; of last whorl, 25; diameter, 17 mm. U. S. Nat. Mus. Cat. No. 101068.

Type-locality.—West Mexico, received from Prof. Alfred Dugès. This belongs to the group of *M. curta* Sowerby, but is a much thinner and more elegant shell.

MARGINELLA POLITULA (COOPER MS.), new species.

Shell minute, translucent white, of about two and a half whorls, the spire evident but covered with transparent enamel; it is widest posteriorly but does not attenuate rapidly enough to become pyriform; the aperture is nearly as long as the shell, the outer lip thickened, internally smooth, nearly straight; inner lip polished with three oblique plaits; height of shell, 3; maximum diameter, 1.5 mm, U. S. Nat. Mus. Cat. No. 23240.

Type-locality.—Catalina Island, California, in 30 fathoms, collected by J. G. Cooper.

The differences which separate these small Marginellidae are not great but appear to be constant enough to take specific rank. The present species has long been known among collectors by Doctor Cooper's manuscript name, but so far as I have discovered has never been described, although it was collected by Colonel Jewett in 1849.

MARGINELLA EREMUS, new species.

Shell small, white, smooth, solid, with about four whorls, the nucleus, as in most abyssal species of the genus, being subglobular and relatively large; suture appressed, rather obscure, general form of the shell not unlike that of *M. yucatecana* of the West Indies, but more slender and much smaller; outer lip thickened, especially near the posterior commissure, near which is a single denticle on the inner side of the lip; in front of this a few obscure low nodulations; inner lip with four subequal plaits, including that at the edge of the pillar: height of shell, 5; of last whorl, 4; diameter, 2.4 mm. U. S. Nat. Mus. Cat. No. 207622.

Type-locality.—Near the Galapagos Islands, at U. S. Fish Commission station 2808, in 634 fathoms, sand; bottom temperature 39.9° F.

MARGINELLA ANTICLEA, new species.

Shell minute, smooth, evenly spindle shaped, glistening milk white, with about four whorls, including a moderately large blunt nucleus; suture obscured by a thin coat of enamel; aperture narrow, outer lip

thin, with no internal denticulations; pillar with four plaits, including the thickened edge, the two posterior plaits larger than the others; general form not unlike that of *eremus*, but more slender; height of shell, 3.5; of last whorl, 2.8; diameter, 1.6 mm. U. S. Nat. Mus. Cat. No. 194986.

Type-locality.—U. S. Fish Commission station 2813, among the Galapagos Islands, in 40 fathoms, coral sand.

HYALINA MYRMECOON, new species.

Shell minute, white, smooth, polished, with about three whorls forming a blunt spire, widest near the posterior commissure of the aperture, attenuated in front, sides moderately convex; suture obscure; aperture narrow, outer lip straight, slightly thickened; body with a wash of enamel, pillar with three plaits; height, 3.3; maximum diameter, 1.6 mm. U. S. Nat. Mus. Cat. No. 9440.

Type-locality.—San Diego, California (Brannan). Stearns Collection.

Genus BOREOMELON Dall, 1918.

Type.—*Scaphella stearnsii* Dall, 1872.

The fortunate receipt of some ovicapsules of this species shows that the larval specimens have a smooth, shelly nucleus, so that it must be removed from the Caricellinae, to which it has hitherto been referred, and placed under *Fulgoraria* in the Volutinae. In the absence of the nuclear characters the writer formerly placed this species with *Adelomelon*, though with some doubts.

Genus PHENACOPTYGMA Dall, 1918.

Shell fusiform, with transverse and axial sculpture, elongated canal and apparently simple pillar; the axis in the upper whorls with two well-marked plications.

Type.—*Surculina cortezi* Dall, 1908.

This shell has the appearance of a Pleurotomoid, with the whorl constricted and appressed near the suture and a feeble incurvation of the margin of the lip at the constriction. By grinding away a portion of the apical whorls it was revealed that the axis is furnished with plications which extend to the beginning of the penultimate whorl. It is probably a member of the Volutidae, which family is known to include several genera in which the plaits become obsolete before reaching the aperture, or even, as in *Halia*, completely disappear.

STRIGATELLA (ATRIMITRA) CATALINAE, new species.

Shell solid, black, fusiform, with about seven whorls exclusive of the (lost) nucleus; suture depressed, not deep, the whorls only moderately convex and polished; axial sculpture of extremely fine hardly perceptible incremental lines; spiral sculpture of about four fine in-

conspicuous minutely punctate incised lines, only strong on the very early whorls, obsolete on the last whorl, with wide interspaces crossed by almost microscopic spiral striae; aperture narrow, the canal hardly differentiated, the enamel very dark, only the plaits whitish, the anterior plait feeble, only distinct in the completely adult shell, the other three conspicuous and strong. Height of shell, 29; of last whorl, 20; of aperture, 15; diameter, 11 mm. U. S. Nat Mus. Cat. No. 219648.

Type-locality.—San Pedro, California, Mrs. Baldridge.

No special name having been applied to the group of black Strigatellas of the Pacific coast, although their similarities are so striking, I have proposed the designation *Atrimitra* (1918).

STRIGATELLA (ATRIMITRA) DIEGENSIS, new species.

Shell small, blackish brown, slender, with a whitish nucleus of about three whorls and four subsequent whorls; the initial part of the nucleus very small and forming a blunt apex, the whole nucleus smooth and changing suddenly to the normal sculpture; the latter begins with four rounded, somewhat undulated strong spiral cords with narrower interspaces; on the next whorl the cords have flattened out and the much narrower interspaces are channeled; on the subsequent whorls the cords become still flatter and wider and the interspaces narrow grooves, occasionally punctate from the intersection of incremental lines otherwise hardly visible; on the last whorl the grooves are obsolete on the middle of the whorl, but there are half a dozen feeble threads on the base and canal; the suture is closely appressed; aperture narrow, simple, outer lip hardly thickened, body erased, pillar with two prominent and one obscure plait; canal not differentiated; height of shell, 14; of last whorl, 11; of aperture, 8 mm.; diameter 5.5 mm. U. S. Nat. Mus. Cat. No. 252998.

Type-locality.—San Diego, California; White Collection.

STRIGATELLA (ATRIMITRA) MEXICANA, new species.

Shell large, solid, originally black, but the type-specimen is now decorticated and has lost its nucleus; spire acute, of more than seven moderately rounded whorls, the apex defective; spiral sculpture on the early whorls of half a dozen feeble flattish cords with narrower interspaces, stronger near the preceding suture, absent on the anterior part of the whorl; these continue but less obviously on the last whorl and similar but stronger cords appear on the base, the peripheral region remaining smooth; the canal hardly differentiated but slightly recurved, forming a well marked fasciole; pillar with three strong plaits about midway of the aperture; length of shell, 72; of last whorl, 48; of aperture, 35; maximum diameter, 24 mm. U. S Nat. Mus. Cat. No. 274124.

Type-locality.—U. S. Fish Commission station 3011, off Guaymas, Mexico, in 71 fathoms, sand.

VOLUTOPSIUS ROTUNDUS, new species.

Shell large, slender, rather thin, with a distinct almost constricted suture and more than five rounded whorls (the extreme apex defective); white or pinkish with a thin dehiscent pale straw-colored periostracum; axial sculpture on the apical whorls of a few, irregular, low plications, mostly with narrower interspaces; on the rest of the shell only irregular incremental rugosities; spiral sculpture on the last whorl behind the base, of half a dozen obscure low cords with wider interspaces; on the base these cords number about 15, becoming more regular and close anteriorly; the canal is still more finely and closely threaded; aperture elongate, outer lip thin, body and pillar erased; canal short and wide. Height of four whorls, 105; of last whorl, 75; diameter, 40 mm. U. S. Nat. Mus. Cat. No. 206350.

Type-locality.—Kodiak Island, Alaska; Fisher.

This is also rather common in Cook's Inlet, and may prove to be a *Beringius.*

VOLUTOPSIUS FILOSUS, new species.

Shell small, solid, fusiform, of a livid flesh color with grayish white outer coat and dehiscent olivaceous periostracum and about six whorls, the nucleus decorticated; suture distinct, rather deep; sculpture of uniform fine flattish threads, close-set, about two to a millimeter, covering the whole surface, with axial sculpture of fine inconspicuous incremental lines; whorls evenly rounded but not inflated; aperture elongate, the outer lip thickened and slightly reflected; the body and rather straight pillar thickly enameled; canal short and wide, slightly recurved, with a feeble fasciole; the operculum is brown, narrow, parallel-sided, with the nucleus at the right-hand corner. Height of shell, 64; of last whorl, 52; diameter, 30 mm. U. S. Nat. Mus. Cat. No. 223055.

Type-locality.—U. S. Fish Commission station 3283, off the Khudubine Islands, Bering Sea, in 39 fathoms, sand; bottom temperature, 40.3° F.

VOLUTOPSIUS MIDDENDORFFII, new variety EMPHATICUS.

Shell smaller than the average typical *middendorffi*, with the fine spiral striae and threadlike incremental lines emphasized so as to form a fine cloth-like reticulation on the surface. A female specimen measures, height of shell, 92; of last whorl, 70; diameter, 50 mm. U. S. Nat. Mus. Cat. No. 205368.

Type-locality.—U. S. Bureau of Fisheries station 4982, in the Japan Sea, in 390 fathoms, mud; bottom temperature, 32.7° F.

VOLUTOPSIUS DIMINUTUS, new species.

Shell small for the genus, pale flesh color, with six whorls, of which about two (decorticated) belong to a swollen nucleus apically blunt; the spire is rather attenuated, the whorls moderately rounded, the suture narrow and deep; surface in front of the suture smooth halfway to the periphery on the last whorl then spirally sculptured with numerous shallow grooves, with much wider flat interspaces, the grooves almost punctuate by the incremental sculpture which also gives them a more or less minutely irregular course and transversely striates the interspatial surfaces; aperture lunate, the outer lip somewhat expanded and thickened, the body and pillar callous, the canal short and wide, a little recurved; height of shell, 42; of last whorl, 31; diameter, 21 mm. U. S. Nat. Mus. Cat. No. 206829*a*.

Type-locality.—U. S. Bureau of Fisheries station 4844, in the Japan Sea, in 116 fathoms.

BERINGIUS CREBRICOSTATUS, new variety UNDATUS

Specimens (mostly young) differing from the typical form in having about 17 arcuate rounded ribs extending from the constricted suture to the periphery and obsolete on the base; there are also more numerous (about 18) spiral ridges, smaller and of course much closer together than in the case of the typical form. The apex of the largest specimen (about two-thirds grown) is defective, but there are five completed whorls, measuring 78 mm. long and with a diameter of 35 mm. U. S. Nat. Mus. Cat. No. 223031.

Type-locality.—U. S. Bureau of Fisheries station 4224, at Cygnet Inlet, Boca de Quadra, Alaska, in 160 fathoms, mud; bottom temperature, 43.7° F.

BERINGIUS KENNICOTTII, new variety INCISUS.

Shell resembling the typical form but more slender and with the spiral sculpture very sharply emphasized, the striae becoming grooves and the base coarsely threaded. Height of immature shell, 75; of last whorl, 50; diameter, 35 mm. U. S. Nat. Mus. Cat. No. 110488.

Type-locality.—U. S. Bureau of Fisheries station 4779, on Petrel Bank, Bering Sea, in 54 fathoms, gravel.

In a large series of the typical *B. kennicottii* I find the axial ribs varying in number on the last whorl from 9 to 19; the specimens with the more numerous ribs and inflated whorls, being usually females who have to carry the material for the large ovicapsules.

BERINGIUS MARSHALLI, new species.

Shell large and thin, livid flesh color, with a dehiscent, thin, pale brownish periostracum; suture distinct, constricted, the whorl slightly flattened in front of it; spire attenuate with seven whorls

exclusive of the (lost) nucleus, the apical whorls feebly irregularly axially plicate, the others with only rather conspicuous silky incremental lines; at the shoulder on the last whorl are developed low oblique, irregular ridges with wider interspaces; a few also appear near the periphery; on the base there are about eight low obscure ridges with wider interspaces; aperture ovate, pinkish brown within, outer lip thin, body and pillar with a thin layer of enamel, the pillar nearly straight, as is the wide short canal: the operculum large, black, with apical nucleus. Height of shell, 144: of last whorl, 100: diameter, 54 mm. U. S. Nat. Mus. Cat. No. 224077.

Type-locality.—U. S. Bureau of Fisheries station 3549, in Bering Sea, off Unalaska, in 78 fathoms, sand; bottom temperature, 40.1° F.

Named in honor of Mr. W. B. Marshall of the National Museum staff and well known as a student of fresh water mollusca.

BERINGIUS INDENTATUS, new species.

Shell large, short-spired, acute, solid, livid whitish, with a thin dehiscent pale brownish periostracum and six shouldered whorls exclusive of the (lost) nucleus: axial sculpture of (on the penultimate whorl, 14) rounded, arcuate ribs, with wider interspaces, most prominent at the shoulder but extending over the periphery almost to the canal, though somewhat irregularly disposed: other axial sculpture of rather conspicuous crowded incremental lines: spiral sculpture none, on and near the periphery of the last whorl are a few more or less obsolete irregularly divergent raised lines: aperture wide, white, throat pinkish, outer lip thin, expanded, body and pillar thickly enameled, pillar straight, canal short, shallow, wide, hardly recurved: operculum dark brown, chrysodomoid, the scar of attachment relatively small. Height of shell, 110: of last whorl, 78: diameter, 58 mm. U. S. Nat. Mus. Cat. No. 213315.

Type-locality.—U. S. Fish Commission station 3282, off the Khudubine Islands, Bering Sea, in 53 fathoms mud: bottom temperature, 38.2° F.

This belongs to the group of *B. kennicottii.*

ANCISTROLEPIS EUCOSMIUS, new variety BICINCTUS.

Shell resembling typical *eucosmius,* but with, on the spire, only two strong spiral ridges, equidistant from the sutures, and on the base three more adjacent, smaller, and diminishing in size and separation toward the canal. The surface is covered with a delicately reticulated, velvety periostracum of a pale olive color over white shelly matter. The operculum is normal. Height, 28: diameter, 17 mm., the apex slightly eroded. U. S. Nat. Mus. Cat. No. 122673.

Type-locality.—U. S. Fish Commission station 3337, southeast of Unalaska, Alaska, in 280 fathoms, mud.

ANCISTROLEPIS CALIFORNICUS, new species.

Shell of moderate size, solid, white, with an olivaceous periostracum, with about seven whorls, excluding the (defective) nucleus, with the sutural channel almost obliterated; apical whorls with two, later whorls with three strong but not sharp carinae, revolving nearly equidistant between the sutures, the posterior carina slightly smaller than the others; on the base are about half a dozen similar carinae beside the small spiral threads on the canal; other spiral sculpture of minute striae and threads pretty uniform over the surface, with an occasional stronger intercalary thread; axial sculpture of faint irregular incremental lines on which the periostracum is sometimes raised; aperture white, internally reflecting the stronger sculpture; outer lip thin, not reflected, body erased, pillar short, strong, sharply twisted, with a short wide canal. Height of shell, 46; of last whorl, 33; diameter, 30 mm. U. S. Nat. Mus. Cat. No. 122667.

Type-locality.—U. S. Fish Commission station 2919, in 984 fathoms, mud, near the Cortez bank off the coast of southern California.

This is a larger and more conic shell than *A. eucosmius* and has fewer keels.

ANCISTROLEPIS BERINGIANUS, new species.

Shell large, solid, livid whitish, with a long acute spire, the apex defective, but the shell had more than six whorls, separated by a very narrow deep suture and covered by a very thin pale olivaceous periostracum; whorls well rounded, with four or five nearly obsolete flattish spiral ridges between the base and the shoulder, with wider interspaces, the base delimited by a stronger cord, in front of which are eight or ten similar flattish spirals more closely set. There is also a very minute scratchy spiral striation; axial sculpture only of rather rude incremental lines; aperture short and wide, the outer lip thin, not expanded, the body erased, the pillar short, white, twisted, the axis not quite pervious, and with a feeble fasciole. Height of five whorls, 98; of last whorl, 66; of aperture and short wide canal, 51; diameter, 52 mm. U. S. Nat. Mus. Cat. No. 205401.

Type-locality.—U. S. Bureau of Fisheries station 4794, in western Bering Sea, off Starichkoff Island, in 58 fathoms, gravel.

ANCISTROLEPIS TROCHOIDEUS Dall.

Shell small, short, wide, white, with about five whorls, the nucleus eroded, white, with a pale olive, minutely laminate periostracum; upper whorls with two later with four angular keels, with smaller intercalary cords, the base with seven strong rounded cords with equal interspaces; axial sculpture of fine incremental lines on which at regular intervals the periostracum is laminar; aperture wide,

white, the body and pillar with a thick coat of enamel, the pillar short, twisted, with a wide canal. Height, 30; height of last whorl, 24; diameter, 20 mm. U. S. Nat. Mus. Cat. No. 205098.

Type-locality.—Off Yokohama, Japan, in 600 fathoms.

This is *Chrysodomus trochoideus* Dall, 1907.

PLICIFUSUS (RETIFUSUS) INCISUS, new species.

Shell of moderate size, whitish, with a yellowish brown periostracum and about seven well-rounded rapidly increasing whorls, the nucleus eroded; suture distinct, deep; axial sculpture of numerous retractively arcuate small plications with subequal interspaces, extending from suture to suture, but becoming obsolete on the last part of the last whorl; the incremental lines evident but not conspicuous; spiral sculpture of (on the penultimate whorl about 8) flattish pairs of spirals divided by a shallow groove and the pairs separated by deeper, narrower, somewhat channeled grooves; between these and the preceding suture is a narrow band of closer threads; the former sculpture extends to the canal with much uniformity; aperture rather wide, the outer lip arcuate thin simple; the body with a thin layer of callus; the pillar straight; the canal short, wide, recurved; the operculum normal, with a glazed border on the inner side. Height of shell, 38; of last whorl, 26; of aperture, 19; diameter, 18 mm. U. S. Nat. Mus. Cat. No. 225614.

Type-locality.—U. S. Fish Commission station 3643, in the western Bering Sea, in 100 fathoms, sand; bottom temperature, 31.7° F.

PLICIFUSUS (RETIFUSUS) OCEANODROMAE, new species.

Shell of moderate size, buccinoform, acute, white, of about seven whorls, moderately rounded, the suture distinct, not appressed; axial sculpture of (on the last whorl about 22) narrow, rounded, retractively arcuate ribs, with subequal interspaces, extending from the suture to the base; the incremental lines not prominent; spiral sculpture of close-set flattish threads of somewhat irregular strength, often medially grooved, and having a tendency to associate in groups of two or three, these cover the whole surface; aperture buccinoid, retractively conspicuously waved near the suture, protractively arcuate beyond; throat white, body with a glaze, pillar slightly arcuate, canal wide, recurved; operculum with apical nucleus; height of shell, 34; of last whorl, 25; of aperture, 17; diameter, 16 mm. U. S. Nat. Mus. Cat. No. 205923.

Type-locality. U. S. Fish Commission station 4777, on Petrel Bank, Bering Sea, in 52 fathoms, gravel.

COLUS (LATIFUSUS) PHARCIDUS, new species.

Shell of moderate size, white under an olivaceous periostracum, with six well-rounded whorls exclusive of the (lost) nucleus; suture dis-

tinct, deep; axial sculpture of faint incremental lines; spiral sculpture of a very few hardly visible lines in front of the suture on the upper whorls and near the canal; beside these there are irregular divergent raised lines on the periphery, such as have been noted in a number of species but which are doubtfully normal; aperture semilunate, outer lip thin, sharp, slightly arcuate, inner lip erased, pillar short, twisted, attenuate in front, axis pervious; canal wide, short, strongly recurved; height of shell, 30; of last whorl, 22; of aperture, 15; diameter, 15 mm. U. S. Nat. Mus. Cat. No. 205243.

Type-locality.—U. S. Bureau of Fisheries station 5015, in the Sea of Okhotsk, in 510 fathoms, green mud; bottom temperature, 35.9° F

The operculum is normal.

COLUS (AULACOFUSUS) NOBILIS, new species.

Shell large, regular, acute, whitish, with a warm yellow-brown persistent periostracum with eight whorls, exclusive of the very minute (lost) nucleus, separated by a very sharply defined suture, and elegantly rounded; spiral sculpture of (on the penultimate whorl about 15) flattened revolving close-set cords either in pairs or medially grooved for the most part, practically uniform over the whole shell; axial sculpture only of fine silky incremental lines; aperture rather wide, the outer lip expanded, thin, more or less crenulated internally by the effect of the external sculpture; body and pillar with a thick, continuous coat of enamel; canal distinct, short, slightly recurved; operculum solid, blackish, with apical nucleus. Height of shell, 85; of last whorl, 55; of aperture, 43; diameter, 38 mm. U. S. Nat. Mus. Cat. No. 222983.

Type-locality.—U. S. Fish Commission station 3484, in Bering Sea, near the Pribilof Islands, in 60 fathoms, mud; bottom temperature, 37.4° F.

COLUS (AULACOFUSUS) OMBRONIUS, new species.

Shell of moderate size, white with a dull olive gray periostracum, of more than six well-rounded whorls, the nucleus missing, the aperture longer than the spire; suture distinct; not appressed; axial sculpture of rather strong, regular and regularly spaced incremental lines which minutely corrugate the spirals; spiral sculpture of (on the penultimate whorl about a dozen) flattish cords, equal and equally spaced with much narrower interspaces; on the last whorl, especially near the periphery, these cords have a tendency to become keeled and the interspaces wider; aperture ovate, simple, the outer lip slightly expanded and reflecting the external sculpture, throat white, inner lip enameled, pillar twisted, almost pervious; canal two-thirds as long as the rest of the aperture, well recurved, height of shell, 50; of last whorl, 37; of aperture, 30; diameter, 21 mm. U. S. Nat. Mus. Cat. No. 213239.

Type-locality.—U. S. Fish Commission station 3252, in Bering Sea, between Bristol Bay and the Pribilof Islands, in about 30 fathoms, mud; bottom temperature, 44.8° F.

COLUS (AULACOFUSUS) ADONIS, new species.

Shell small, bulimiform, thin, whitish with a pale olive periostracum, with about six whorls exclusive of the (lost) nucleus, with a very narrowly channeled suture and moderately rounded whorls; spiral sculpture of narrow equal flat threads (about three to a millimeter) with very narrow interspaces over the whole shell, though the interspaces are a little wider on the apical whorls and the spirals under-run there by thread-like axial sculpture, giving a somewhat punctate appearance under magnification; aperture elongate, rather narrow, the outer lip thickened, not reflected, with traces of liration near the inside margin; the body and pillar with a continuous layer of enamel; canal short, wide, with no siphonal fasciole. Height of shell, 37; of last whorl, 25; diameter, 15 mm. U. S. Nat. Mus. Cat. No. 205212.

Type-locality.—U. S. Bureau of Fisheries station 5053, in Suruga Gulf, Japan, in 503 fathoms, mud; bottom temperature, 34.9° F.

The operculum is Chrysodomoid, but the liration is almost unique in the group and derives from the external sculpture.

COLUS (AULACOFUSUS) BRISTOLENSIS, new species.

Shell small, white under an olivaceous periostracum, with six rounded whorls and a very minute (decorticated) nucleus; suture distinct, not appressed; spiral sculpture of (on the penultimate whorl about 14) shallow grooves, becoming fainter on the last whorl, with much wider flat interspaces; axial sculpture of faint incremental lines; aperture wide, semilunate, the outer lip sharp, thin, arcuate; body with a thin coat of whitish enamel; pillar short, twisted, attenuated in front; canal short, wide, recurved; height of shell, 23.5; of last whorl, 18; of aperture, 13; diameter, 11.5 mm. U. S. Nat. Mus. Cat. No. 213254.

Type-locality.—U. S. Fish Commission station 3252, in Bering Sea, between Bristol Bay and the Pribiloff Islands, in 29½ fathoms, mud; bottom temperature, 44.8° F.

COLUS (AULACOFUSUS) BARBARINUS, new species.

Shell small, solid, pale gray, of about six whorls, the nucleus compressed axially and rather acute, suture distinct, not appressed, whorls conspicuously rounded; there is no axial sculpture except faint incremental lines, the apical whorls are decorticated; spiral sculpture of incised lines with slightly rounded wider interspaces, about a dozen on the penultimate whorl, quite uniform over the whole of the last

whorl; aperture ovate, outer lip thin, sharp; inner lip erased, white; pillar short, twisted; canal short, rather wide, somewhat recurved. Height of shell, 20; of last whorl, 14; of aperture, 10; diameter, 9 mm. U. S. Nat. Mus. Cat. No. 334438.

Type-locality.—U. S. Fish Commission station 3282, off Khudubine Island, Bering Sea, in 53 fathoms; bottom temperature, 38.2° F.

The operculum is normal and rather large for the size of the shell.

COLUS (AULACOFUSUS) SAPIUS, new species.

Shell small, thin, the apical whorls eroded, but six prominently rounded turns remain; suture distinct, not appressed, the whorl in front of it flattened and without spiral sculpture for a short distance; the shell is white with a straw-colored periostracum; axial sculpture of faint incremental lines; spiral sculpture of (on the penultimate whorl about eight) strong squarish cords with subequal rather deep, channeled interspaces, both slightly wrinkled by the incremental lines and obsolete on the canal; there are a few minor spirals behind the posterior cord; aperture roundly ovate, outer lip thin, simple, inner lip erased, pillar white, twisted, axis pervious; canal rather long, narrow, well defined, somewhat recurved; height of shell, 22; of last whorl, 15; diameter, 11 mm. U. S. Nat. Mus. Cat. No. 122597.

Type-locality.—U. S. Fish Commission station 2859, southwest of Sitka, Alaska, in 1,569 fathoms, ooze.

COLUS (AULACOFUSUS) CALATHUS, new species.

Shell small, thin, white under a straw-colored periostracum, with more than six well-rounded whorls, the apex defective; suture distinct, not appressed; axial sculpture of faint incremental lines; spiral sculpture of (on the penultimate whorl 13) fine rounded low subequal cords with narrower interspaces, the cords at and below the periphery a little more close-set, this sculpture covering the whole shell very evenly; aperture wide, the outer lip thickened and slightly crenulated by the external sculpture, body erased; pillar short, attenuated in front; canal short, wide, slightly recurved; height of shell, 26; of last whorl, 18; of aperture, 12; diameter, 13 mm. U. S. Nat. Mus. Cat. No. 106864.

Type-locality.—U. S. Fish Commission station 2853, near the Shumagin Islands, Alaska, in 159 fathoms, sand.

COLUS (AULACOFUSUS) CAPPONIUS, new species.

Shell of moderate size, the spire longer than the aperture, white, with a thin polished, olivaceous periostracum, and more than five whorls (the apex defective); whorls moderately rounded, suture distinct, deep; axial sculpture of fine silky incremental lines, sometimes with a tendency to cause wrinkles near the suture; spiral sculpture

of (on the penultimate whorl about 17) regular narrow rather deep grooves with much wider flattish interspaces, uniformly covering the whole surface of the shell; aperture about twice as long as wide, outer lip retractively arcuate behind and protractively anteriorly, not reflected; pillar lip with a thin glaze, pillar white; canal short, wide, hardly reflected; height of shell, 40; of last whorl, 27; of aperture, 18; diameter, 18 mm. U. S. Nat. Mus. Cat. No. 108980.

Type-locality.—Bering Strait, near Port Clarence, W. H. Dall.

COLUS (AULACOFUSUS) HALIDONUS, new species.

Shell of moderate size, short, stout, white with an olivaceous periostracum, with about six whorls, the apex defective, suture distinct, not appressed; axial sculpture of fine, equal, close-set incremental lines; spiral sculpture of (on the penultimate whorl about 16) fine channeled grooves with wider flat interspaces, of which two behind the suture are wider than the others; on the base the posterior edge of these interspaces is raised and the anterior lowered to the level of the bottom of the grooves giving the effect of narrow threads with much wider intervals; these two varieties of sculpture cover the whole shell; aperture wide, the outer lip somewhat reflected, body erased, pillar short, gyrate, axis pervious; canal short, very wide, recurved and flaring anteriorly; operculum normal; height of shell, 35; of last whorl, 27; of aperture, 20; diameter, 20 mm. U. S. Nat. Mus. Cat. No. 213250.

Type-locality.—Off Destruction Island, Washington, in 516 fathoms.

AULACOFUSUS (LIMATOFUSUS) PULCIUS, new species.

Shell of moderate size, of about six rounded whorls, the apex eroded, shell substance of a pale livid brown, covered by an olivaceous periostracum, the suture distinct and deep; axial sculpture of uniform fine silky incremental lines; spiral sculpture of uniform flattened spirals separated by narrow grooves, about 27 to 30 spirals on the penultimate whorl; aperture ovate, outer lip thin (immature?) slightly crenulated by the external sculpture, inner lip erased, brownish, pillar white, straight; canal short, wide, deep, forming a well marked fasciole; height of shell, 38; of last whorl, 26; of aperture, 18; diameter, 17 mm. U. S. Nat. Mus. Cat. No. 223799.

Type-locality.—Arctic Ocean, north of Bering Strait, collected by Capt. M. A. Healy of the revenue marine steamer *Corwin*.

Operculum normal, dark brown.

AULACOFUSUS (LIMATOFUSUS) TIMETUS, new species.

Shell small, thin, with a thin pale olive periostracum, and five or more whorls, the apex eroded; suture distinct, not appressed; axial sculpture none; spiral sculpture of (on the penultimate whorl about

33) fine regular sharp striae with wider flat interspaces, for the most part uniform, but near the periphery tending to be wider, this sculpture covering the whole surface; aperture wide, semilunate, outer lip gently arcuate, thin, inner lip erased, white, pillar straight, attenuated in front, canal wide, deep, very short, with a well-marked siphonal fasciole; height of shell, 30; of last whorl, 22; of aperture, 15; diameter, 16 mm. U. S. Nat. Mus. Cat. No. 213337.

Type-locality.—U. S. Fish Commission station 3333, off Iliuliuk Harbor, Captains Bay, Unalaska, Aleutian Islands, in 19 fathoms, mud; bottom temperature 43.9° F.

AULACOFUSUS (LIMATOFUSUS) TROPHIUS, new species.

Shell of moderate size, short, white, with a pale olivaceous periostracum with more than five well-rounded whorls, the apex eroded; suture distinct, not appressed; axial sculpture of faint concavely arcuate incremental lines; spiral sculpture of (on the penultimate whorl about a dozen) sharp narrow channeled grooves, with considerably wider flat interspaces, which, on the last whorl, are more or less divided by a shallow median groove; this sculpture is practically uniform over the whole surface; aperture wide, simple, white within; outer lip slightly reflected, thin, body erased; pillar short, straight; axis pervious; height of shell, 32; of last whorl, 26; of aperture, 21; d ameter, 19 mm. U. S. Nat. Mus. Cat. No. 122628.

Type-locality.—U. S. Fish Commission station 3071, in 685 fathoms, mud, off Sea Lion Rock, coast of Washington.

AULACOFUSUS (LIMATOFUSUS) MORDITUS, new species.

Shell small, solid, polished, of about seven whorls, the apex decorticated, rather acute, the whorls moderately rounded, the suture distinct, not appressed; axial sculpture of feeble incremental lines, their intersections slightly punctating the grooves; spiral sculpture of numerous shallow grooves with much wider flattish interspaces over the whole surface; outer lip thin, sharp, arcuate; inner lip erased, pinkish, pillar white, attenuated in front; canal wide, distinct, short, slightly recurved; height of shell, 28; of last whorl, 20; of aperture, 15; diameter 13 mm. U. S. Nat. Mus. Cat. No. 222599.

Type-locality.—U. S. Fish Commission station 4198, in the Gulf of Georgia, in 200 fathoms, mud; bottom temperature, 48.6° F.

There are numerous irregular branching grooves on the surface, like the burrows of *Cliona*, but I regard them as abnormal and probably due to some parasite. The operculum is normal.

AULACOFUSUS (LIMATOFUSUS) DIMIDIATUS, new species.

Shell small, white, with a pale olivaceous periostracum, with five or more rounded whorls (the apex defective and the specimens not quite mature) separated by a rather deep suture; spiral sculpture

peculiar, consisting of numerous crenulated grooves with much wider slightly concave interspaces disposed without regularity but on the last whorl numbering over 30, the interspaces widest near the periphery; the crenulation of the grooves is probably due to incremental lines not elsewhere especially noticeable; aperture elongate, outer lip (immature) thin, sharp; body and pillar erased; canal rather long and recurved; axis pervious; operculum thin, the nucleus apical, somewhat curved to the left; height of shell, 16; of last whorl, 12; diameter, 8 mm. U. S. Nat. Mus. Cat. No. 213338.

Type-locality.—U. S. Fish Commission station 3346, off Tillamook Bay, Oregon, in 786 fathoms, ooze; bottom temperature, 37.3° F.

The sculpture is different from that of any other of the group I have been able to examine.

AULACOFUSUS (LIMATOFUSUS) SEVERINUS, new species.

Shell small, white, covered with a straw-colored periostracum, with about six rounded whorls, the apex eroded, the suture distinct, not appressed; axial sculpture of obscure incremental lines; spiral sculpture of slightly irregular flattish cords separated by narrower channeled grooves; on the penultimate whorl there are 15 to 17 of these cords; beside these the surface is profusely scored with incised, more or less oblique, sometimes divaricate grooves, which I take to be abnormal; aperture wide, outer lip convexly arcuate, slightly expanded and thickened; inner lip with a layer of white enamel, pillar short; canal very short, wide, deep, recurved; operculum normal, dark brown; height of shell, 33; of last whorl, 25; of aperture, 17; diameter, 18 mm. U. S. Nat. Mus. Cat. No. 225225.

Type-locality.—U. S. Fish Commission station 3669, Bay of Monterey, California, in 278 fathoms, sand; bottom temperature, 42.7° F.

AULACOFUSUS (LIMATOFUSUS) HALIMERIS, new species.

Shell small, whitish with a yellow-brown periostracum and five whorls, including a swollen subglobular nucleus, spire otherwise rather acute, the whorls moderately rounded; suture distinct, not appressed; spiral sculpture of numerous fine shallow squarish grooves, separated by wider flattish interspaces, these covering the whole surface; axial sculpture of faint incremental lines; aperture ovate, outer lip thin, simple, body erased, pillar short and twisted; canal short, wide, recurved; height of shell, 21; of last whorl, 15; of aperture, 11; diameter, 10 mm. U. S. Nat. Mus. Cat. No. 207192.

Type-locality.—U. S. Fish Commission station 4248, in Eastern Passage, near the Stikine River, southeastern Alaska, in about 70 fathoms, mud; bottom temperature, 42.8° F.

The specimen may not be completely adult.

AULACOFUSUS (LIMATOFUSUS) TROMBINUS, new species.

Shell small, short, rotund, with about five whorls, the apex eroded, white with a pale olivaceous dull periostracum; suture distinct, not appressed; axial sculpture of fine, regular, almost microscopic, incremental lines crossing the outer sculpture but hardly visible except with a lens; spiral sculpture of (on the penultimate whorl about 10, on the last whorl about 25) narrow, almost channeled grooves, with slightly rounded broader interspaces, sometimes divided by a smaller groove, and feebler near the suture and on the canal; outer lip thin, sharp, arcuate; inner lip erased, pillar white, short, twisted; canal short, wide, distinctly recurved; operculum normal, rather short and wide, in harmony with the aperture; height of shell 16; of last whorl, 14; of aperture, 11; diameter, 10 mm U. S. Nat. Mus. Cat. No. 213332.

Type-locality.—U. S. Fish Commission station 3253, in Bering Sea, off the Pribiloff Islands in 36 fathoms; bottom temperature, 35° F.

COLUS (LATISIPHO) ERRONES, new species.

Shell of moderate size, dark reddish brown, acute, with six rapidly increasing moderately convex whorls and a glassy subglobular smooth nucleus of about one whorl; suture distinct, not appressed; periostracum polished; axial sculpture of faint incremental lines; spiral sculpture of the early whorls of numerous fine striae, covering the whole surface with wider flat interspaces; this sculpture continues, becoming less and less evident until except under a lens the surface appears to be smooth except on the canal; aperture semilunate, outer lip thin, simple, sigmoidly arcuate; throat whitish, body with a thin callus, pillar straight, attenuated in front; canal short, wide, strongly recurved; height of shell, 47; of last whorl, 32; of apertnre, 23; diameter, 22 mm. U. S. Nat. Mus. Cat. No. 226227.

Type-locality.—Bering Sea, U. S. Fish Commission.

COLUS (LATISIPHO) CLEMENTINUS, new species.

Shell small, white, with a greenish olive periostracum, and more than five rounded whorls, the apex decorticated; suture distinct, not appressed; axial sculpture of irregularly prominent incremental lines; spiral sculpture of a few irregular interrupted spiral threads, probably accidental, and some feeble grooves near the canal; surface practically smooth, almost polished; aperture semilunate, the outer lip thin, arcuate, body with a coat of white enamel, the pillar white, short, twisted, attenuate in front; canal wide, short, slightly recurved; height of shell, 21; of last whorl, 15; of aperture, 11; diameter, 10 mm. U. S. Cat. Mus. Cat. No. 208912.

Type-locality.—U. S. Fish Commission station 4405, between Santa Catalina and San Clemente Islands, California, in 654 to 704 fathoms, mud; bottom temperature, 39.4° F.

COLUS (LATISIPHO) DALMASIUS, new species.

Shell of moderate size, acute, white, covered with a dark reddish brown periostracum with a subglobular polished nucleus of about one whorl and six subsequent well-rounded, rapidly enlarging whorls; suture distinct, not appressed; axial sculpture of feeble incremental lines; spiral sculpture of numerous flattened threads with narrow obscurely channeled interspaces, coarser on the canal; aperture wide, outer lip thickened, arcuate, slightly expanded; body with a thin white layer of callus, pillar short, twisted; canal wide, short, strongly recurved; height of shell, 35; of last whorl, 25; of aperture, 18; diameter, 20 mm. U. S. Nat. Mus. Cat. No. 122631.

Type-locality.—U. S. Fish Commission station 2862, off the coast of British Columbia, in 238 fathoms, sandy bottom.

This is a dwarfish imitation of *L. errones*.

CHRYSODOMUS SMIRNIUS, new species.

Shell of moderate size, acute, livid purple-brown, with a semitranslucent whitish overlayer, and a thin dehiscent olivaceous periostracum; nucleus small, irregularly swollen, of about one whorl, with about five subsequent whorls; the earlier two or three whorls have four or five low, wide, flat spiral cords with obscurely channeled interspaces, these rapidly become obsolete and the last whorl appears quite smooth except for fine silky incremental lines: suture distinct, somewhat appressed; aperture wide, ovate, angular behind, the outer lip expanded, white, the throat dark brown, the body with a thin glaze which extends to the pillar, which is twisted and attenuated; the canal short, wide, somewhat recurved; operculum normal. Height of shell, 50; of last whorl, 39; of aperture, 30; maximum diameter, 26 mm. U. S. Nat. Mus. Cat. No. 130418.

Type-locality.—U. S. Fish Commission station 3461, in the Straits of Fuca, in 114 fathoms, sand, bottom temperature 44.2° F. The species ranges northward to Bering Sea. The type-specimen is a female.

CHRYSODOMUS NUCEUS, new species.

Shell small for the genus, solid, yellowish, rather acute, with six whorls exclusive of the (lost) nucleus, suture distinct, narrow, deep; spiral whorls flattish behind the periphery at which there is an obscure angle; in front of this are a few obscure spirals, indicated by color rather than elevation in the type-specimen; incremental lines inconspicuous, rather rude; aperture white, outer lip sharp, slightly expanded; body and pillar with a thick white enamel; canal short,

recurved, with a strong fasciole. Height of shell, 62; of last whorl, 50; diameter, 35 mm. U. S. Nat. Mus. Cat. No. 151429.

Type-locality.—Cook's Inlet, Alaska; Arnheim.

This species ranges to the Arctic Ocean.

CHRYSODOMUS PRIBILOFFENSIS, new species.

Female shell, rather thin, inflated, short spired, with about six whorls exclusive of the (lost) nucleus; the suture distinct with a flattish or slightly excavated space on the whorl in front of it, beyond which the whorl is evenly rounded; the color is a warm buff, increasing to orange on the enamel of the pillar; axial sculpture of fairly obvious, fine, incremental lines; spiral sculpture of a strong cord at the shoulder, 2 on the apical whorls, 3 on the penultimate whorl, 8 or 10 on the last whorl, of which that at the shoulder is the strongest; between these cords are three to five flattish, less elevated close-set threads, except on the canal, where the spirals are wider, flatter, and more or less obsolete; aperture broad, outer lip thin, sharp, body and pillar with a layer of enamel, the pillar short, strongly twisted; the canal rather wide with no marked fasciole; the operculum black, rather wide, ovate with apical nucleus bent to the left. Height of shell, 94; of last whorl, 77; diameter, 60 mm. U. S. Nat. Mus. Cat. No. 225603.

Type-locality.—Off the Pribilof Islands, Bering Sea, in 50 to 100 fathoms.

CHRYSODOMUS VINOSUS, new species.

Shell thin, with acute spire, of a pinkish flesh color intensified to vinose near the apex, the nucleus bulbose, swollen, of one whorl, with five subsequent rapidly increasing whorls; suture distinct, deep, very narrow, the whorl in front of it flattish or slightly concave to a prominent darker stronger cord at the shoulder, which on the apical whorls is peripheral; the suture is laid against a weaker cord, the remainder of the surface, obsoletely minutely spirally striated; axial sculpture of rather regular silky incremental lines; aperture wide, the outer lip sharp, body and pillar with a thin layer of enamel; the pillar twisted, the axis pervious, the canal wide and strongly recurved, but showing no fasciole. Operculum black with apical nucleus. Height of shell, 90; of last whorl, 70; diameter, 49 mm. U. S. Nat. Mus. Cat. No. 225608.

Type-locality.—Western Bering Sea and Avacha Bay, Kamchatka, in 16 fathoms.

CHRYSODOMUS SATURUS Martyn, new variety TABULARIS.

Shell of moderate size, very heavy and solid, the six whorls flatly tabulate in front of the suture, rude, of a grayish color, the nucleus lost; the suture distinct, not appressed; the apical whorls finely

spirally closely threaded, but the rest of the shell without sculpture except rude incremental lines; aperture rounded, outer lip heavy, body and very short pillar with a thick coat of enamel; canal short, very narrow and deep, recurved, with wide umbilical cavity between a very prominent fasciole and the enamel of the pillar. Height of shell, 62; of last whorl, 50; diameter, 44 mm. U. S. Nat. Mus. Cat. No. 31350.

Type-locality.—Bering Sea, near Nunivak Island.

All the specimens seen of this singular variety are much worn and mostly somewhat imperfect, so that the complete lengths would probably be greater than those given.

CHRYSODOMUS HYPOLISPUS, new species.

Shell small, yellowish under an olivaceous periostracum, with about five whorls, including a swollen subglobular nucleus wider than the succeeding whorl; suture distinct, not appressed; whorls rapidly enlarging; axial sculpture only of faint incremental lines; spiral sculpture of, on the spire, faint irregular low threads, finer in a band near the preceding suture; on the last whorl these become more evident, though not strong, and extend to the canal; the interspaces are shallow narrow grooves; aperture rather wide, the outer lip thin, sharp; the body erased, the pillar short, twisted; the canal short, wide, recurved. Height of shell, 43; of last whorl, 32; of aperture, 24; diameter, 22 mm. U. S. Nat. Mus. Cat. No. 205246.

Type-locality.—U. S. Bureau of Fisheries station 4991, in the Japan Sea, in 325 fathoms, mud.

The operculum is normal. It is probable that the specimen is not full grown.

BUCCINUM TENUE Gray, 1849.

From the original type of Gray, as determined by Stimpson, various derivatives may apparently be traced, most of which have secured specific rank, while other still exhibit connecting links. Among the latter is a large rude form with much emphasized more or less broken irregular ribs (Cat. No. 224069) and a conspicuous reddish brown periostracum, with more than seven whorls, a deep suture, and cream-colored enamel. The type-specimen measures 89 mm. in length with a diameter of 40 mm. For this form the varietal name of *rhodium* is now proposed. Another form from the eastern coast of Kamchatka in 100 fathoms (Cat. No. 225611) has a strongly constricted suture and about six rotund whorls, with the axial sculpture largely obsolete and the periostracum a very dark olive; this is 52 mm. long and 32 mm. in diameter. In its other characters it agrees with the normal type of the species. I propose for this variety the name of *lyperum*.

BUCCINUM SOLENUM, new species.

Shell of moderate size, acute, white under a dehiscent straw-colored periostracum, with a strongly constricted suture and about six slightly shouldered somewhat rotund whorls, exclusive of the (lost) nucleus; the whorls of the spire are numerously ribbed (about 20 on the penultimate whorl), with slightly oblique riblets most emphatic on the shoulder, obsolete at the periphery and on the last whorl; the incremental lines are prominent, close, and threadlike; spiral sculpture of very minute, closely undulated, close-set striae, which gave a somewhat granular or punctuate aspect to the intervals between the axial threads; on the periphery of the last whorl are a few obsolete, stronger spirals; aperture wide with a conspicuous gutter somewhat in front of the shoulder in the outer lip; a glaze of enamel on the body and pillar, a short shallow recurved canal, and a well-marked siphonal fasciole; the operculum nearly circular, laminose externally, with central nucleus. Height of shell, 47; of last whorl, 34; diameter, 30 mm. U. S. Nat. Mus. Cat. No. 222485.

Type-locality.—U. S. Fish Commission station 3518, off Nunivak Island, Bering Sea, in 36 fathoms, mud; bottom temperature, 40° F. Also off Unimak Island in 46 fathoms.

This is nearest to some mutations of *B. polare* Gray, 1839.

BUCCINUM CHARTIUM, new species.

Shell of medium size, white, with a very pale olive-gray, thin, dehiscent periostracum, with about eight gradually increasing whorls (the nucleus defective) separated by a well-marked suture; spiral sculpture of three rather prominent subequal cords, one at the shoulder, one at the periphery, and one midway between the others, the interspaces equal, wider and carrying two or three intercalary alternating threads; on the last whorl in the type-specimen, in front of the periphery, are about 20 subequal and equally spaced flattish threads with narrower very shallow interspaces; the canal has no spiral sculpture; axial sculpture of fine vertical threads with wider interspaces; aperture more or less sinuous behind, slightly reflected; body white, erased, pillar nearly straight; canal short, wide, recurved with a feeble fasciole; operculum small, smooth, concave, with the nucleus somewhat to the left of the center. Height of shell, 60; of last whorl, 32; diameter, 44 mm. U. S. Nat. Mus. Cat. No. 226270.

Type-locality.—U. S. Bureau of Fisheries station 3709, off Honshu Island, Japan Sea, in 260 fathoms, muddy bottom.

The specimen is a female.

BUCCINUM PEMPHIGUS, new variety MAJOR.

Male shell, large, thin, inflated, white with an adherent olivaceous periostracum, with seven whorls exclusive of the minute (eroded)

nucleus; suture distinct, spiral sculpture of a low narrow keel at the shoulder and numerous flattish, close-set, usually paired or duplex threads, uniformly covering the whole surface; incremental lines inconspicuous; aperture wide, white, the outer lip thin, narrowly reflected; body and pillar with a glaze of enamel; pillar short, straight; canal wide, short, somewhat recurved, with a moderate fasciole; operculum large, rounded triangular with subcentral nucleus. Height of shell, 86; of last whorl, 64; of aperture, 50; diameter, 55 mm. U. S. Nat. Mus. Cat. No. 225248.

Type-locality.—U. S. Fish Commission station 3643, in the western part of Bering Sea, in 100 fathoms, gravel; bottom temperature, 31.7° F.

Some of the specimens are destitute of the keel at the shoulder.

BUCCINUM PLANETICUM, new species.

Female shell of moderate size, acute, with a distinct not constricted suture and seven rounded whorls exclusive of the (lost) nucleus; shell of a warm buff color, the thin periostracum dehiscent; axial sculpture of, on the upper whorls, about a dozen low obscure ribs only apparent behind the periphery and absent on the last whorl; the lines of growth are hardly perceptible; spiral sculpture of very fine close threads, raised slightly into fasciculate bands of five or six threads, the interspaces more distinctly defined on the base than behind the periphery; this sculpture covers the whole shell; the aperture wide, the margin in the type-specimen deeply sulcate behind, hardly reflected, patulous in front; body erased, pillar nearly straight; canal very short, wide, sharply recurved, with a feeble fasciole; height of shell 65; of last whorl, 45; diameter, 35 mm. U. S. Nat. Mus. Cat. No. 223098.

Type-locality.—U. S. Fish Commission station 3305, southwest of Hagmeister Island, eastern Bering Sea, in 23 fathoms, sand; bottom temperature, 41.8° F.

This species seems common to the eastern littorale of Bering Sea, from Nunivak Island to Bristol Bay, and recalls *B. tenebrosum* Hancock.

BUCCINUM RONDINUM new species.

Shell small, pale straw color, thin, with about five well-rounded whorls, the nucleus eroded; suture distinct, not appressed; axial sculpture of fine close minute incremental lines on which the periostracum rises in minute, equal lamellae; spiral sculpture of low minute equal threads with equal or wider interspaces, over the whole surface; aperture with outer lip simple, arcuate, with the extreme margin slightly expanded; inner lip white, erased; pillar short, thin, twisted; canal wide, deeply excavated, hardly differentiated; height of shell, 20; of last whorl, 16; of aperture, 11; diameter, 11 mm. U. S. Nat. Mus. Cat. No. 110534*a*.

Type-locality.—U. S. Fish Commission station 2853, off Alaska Peninsula in 159 fathoms, sand, bottom temperature, 44.8° F.

BUCCINUM CASTANEUM Dall, 1877.

This remarkable species was originally described from an apparently smooth but very minutely spirally striated specimen from the Shumagin Islands. Later I named a variety with three very prominent spiral cords on the last whorl variety *tricarinatum*. I find, however, that Bruguière named a (*Nassa*) *Buccinum tricarinatum*, so I propose for this variety the designation of *triplostephanum*. As the collection has increased, other specimens of this rare species have come to hand extending the limits of its variability. A form without spiral cords but with (on the last whorl about 10) somewhat irregularly arcuate coarse ribs, and larger than the original type, was collected at the island of St. George (Cat. No. 217152) in Bering Sea, at a depth of 30 fathoms; for this the varietal name *fluctuatum* is now proposed. Still another form from the Unimak Pass, Aleutian chain, in 56 fathoms (Cat. No. 213159) is smaller than the original type and has (on the last whorl about 19) more numerous smaller ribs, which on the periphery are more or less broken up into nodules, and has the fine spiral striation fasciculated by the presence at irregular intervals of deeper spiral grooves; for this form the name *incisulum* is now proposed. In the thickening and arcuation of the outer lip all these forms agree, as well as in the other general characters of the type. It would not be surprising if, when a large number of specimens from different localities are brought together, other combinations of the sculptural characters should be revealed.

BUCCINUM ROSSELLINUM, new species.

Shell small, very thin, of a dull dark olive color, the suture deep, not appressed; with about six well-rounded whorls, the apex eroded; axial sculpture of fine, close, even, silky incremental lines; spiral sculpture of fine, close, equal flattish threads on the spire which later take on the aspect of rather wide flat interspaces between shallow grooves, here and there with a slightly more elevated spiral thread; aperture ovate, outer lip thin, sharp, perhaps not quite mature; inner lip white, erased, pillar short, twisted; canal very short, slightly recurved, wide, with a faint siphonal fasciole; height of shell, 27; of last whorl, 21; of aperture, 14; diameter, 16 mm. U. S. Nat. Mus. Cat. No. 206449.

Type-locality.—U. S. Fish Commission station 3340, southeast of Chirikoff Island, Alaska, in 695 fathoms, mud, bottom temperature, 36.8° F.

The operculum is subcircular, thin and normal.

BUCCINUM PHYSEMATUM, new species.

Female shell rather large, thin, inflated, acute, whitish, whorls rapidly enlarging, about six and a half in number, the nucleus decorticated, the suture deep, not channelled; spiral sculpture of very numerous somewhat irregular, fine threads, mostly with narrower interspaces and with little or no tendency to fasciculation, an angle at the margin of the base; penultimate whorl with about 16 narrow, retractively arcuate ribs, extending from suture to suture with wider interspaces but obsolete on the last whorl; aperture wide, cream colored, the outer lip thin, arcuate, reflected, the body erased, the pillar short, slightly twisted, with a wide, very short canal and moderate fasciole. Height of shell, 60; of last whorl, 47; diameter, 40 mm. U. S. Nat. Mus. Cat. No. 122555.

Type-locality.—U. S. Fish Commission station 3253, in Bering Sea, in 29½ fathoms, mud.

This has the aspect of a very large thin *B. angulosum*, but the minor sculpture is quite distinct.

BUCCINUM ANGULOSUM, new variety CNISMATOPLEURA.

Shell thin, white, variable in height, the type-specimen short, acute, with five whorls exclusive of the (lost) nucleus, separated by a distinct suture; axial sculpture of (on the penultimate whorl 11, on the last whorl 8) stout ribs with equal (on the spire) or wider (on the last whorl) interspaces; on the spire these extend from suture to suture without special prominence on any one part of the whorl, but on the last whorl they are obsolescent near the suture and on the base, but on the periphery are very prominent, as if pinched and pulled out, rudely and irregularly; the incremental lines are inconspicuous; the spiral sculpture is like that of the typical form, fine similar uniform striae now and then fasciculated by deeper grooving; aperture wide, outer lip flexuous, thin; body erased, pillar short straight, canal wide, deep, recurved with a strong fasciole. Height of shell, 48; of last whorl, 40; diameter, 36 mm. Another specimen measures—height of shell, 47; of last whorl, 35; diameter (not quite mature), 26 mm. U. S. Nat. Mus. Cat. No. 332759.

Type-locality.—Point Barrow, Arctic coast of Alaska, on the beach. The second specimen, from between Cape Beaufort and Cape Lisburne, has on the penultimate whorl 9 and on the last whorl 11 ribs. This variability is common in this species and isolated individuals are often very unlike.

BUCCINUM ANGULOSUM, new variety TRANSLIRATUM.

Shell of moderate size, thin, somewhat inflated, with about five whorls exclusive of the (lost) nucleus; the suture gently appressed;

spiral sculpture in minor particulars like that of *B. angulosum*, but with four strong rounded cords, with much wider subequal interspaces on the last whorl and eight or more irregular feeble ribs obsolete in front of the suture also on the base; other axial sculpture of very fine hardly visible incremental lines; aperture creamy white, the outer lip thin, hardly reflected, the body glazed, the pillar slender, arcuate, short, with a deep short, rather wide canal and a strong siphonal fasciole; the periostracum thin, pale yellowish, smooth. Height of shell, 46; of last whorl, 36; diameter, 28 mm. U. S. Nat. Mus. Cat. No. 221455.

Type-locality—Point Belcher, Arctic coast of Alaska, on the beach: collected by W. H. Dall.

CANTHARUS EXANTHEMATUS, new species.

Shell small, brownish, with a smooth turbinate rapidly enlarging nucleus of three and a half whorls and three and a half subsequent whorls; suture obscure, somewhat undulate; axial sculpture of (on the penultimate whorl about 18) obscure vertical ribs with somewhat narrower interspaces, extending on the last whorl to the base, and cut by the spiral sculpture into conspicuous nodules; there are also fine slightly raised close-set, incremental lines most conspicuous in the interspaces; the spiral sculpture consists chiefly of a pair of peripheral threads conspicuously nodulating the ribs and another similar thread in front of the suture; as the shell grows, intercalary not nodulous small threads appear in the interspaces, and on the last whorl a few still smaller intercalaries begin; this sculpture also is found on the base; aperture semilunate, simple, body erased; pillar short, canal short, slightly recurved; the interior of the outer lip has five short prominent lirations, similar and subequally spaced; height of shell, 8.5; of last whorl, 6; diameter, 4.2 mm. U. S. Nat. Mus. Cat. No. 96771.

Type-locality—U. S. Fish Commission station 2837, off Lower California in 23 fathoms, sand.

This belongs to the group of *C. orbignyi* Payraudeau.

ANACHIS PHANEA, new species.

Shell small, acute, slender, white, with six flattish whorls exclusive of the smooth glassy nucleus of about one whorl; suture distinct; the first two whorls flat and smooth, the subsequent whorls with (on the last whorl about 14) nearly vertical narrow, straight, rather sharp ribs with shallow much wider insterspaces extending over the periphery; surface polished, base attenuated, smooth, aperture narrow, outer lip simple, body erased, pillar short, axis pervious; canal short, deep, wide, with a marked siphonal fasciole bordered behind with a brown line; there are a few feeble spiral striae on the

back of the canal; height of shell 9; of last whorl, 6; of aperture, 4; diameter, 3.5 mm. U. S. Nat. Mus. Cat. No. 219671.

Type-locality—Salina Cruz, Mexico; C. R. Orcutt.

It is quite probable that a series would show variations of color.

ALIA CALLIMORPHA, new species.

Shell small, yellowish, with brown mottlings under a thin brownish periostracum, with about five whorls; including a small smooth nucleus; suture obscure, whorls only slightly convex on the spire; surface smooth except for a few spiral striae on the canal; aperture narrow, with a rather wide commissure at the posterior junction of the lip and body; outer lip slightly thickened, with four or five denticles on the inner face; body polished, pillar short; canal short and wide; height of shell 5; of last whorl, 3.5; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 271491.

Type-locality.—San Diego, California, C. R. Orcutt.

This belongs with the group of *A. californiana*, from which it differs by its much smaller size, relatively more slender form, and less pronounced coloration.

ALIA XENIA, new species.

Shell large for the genus, acute, waxen white, with abundant reddish brown painting—clouds, streaks, or occellations—with about nine rather flat-sided whorls, exclusive of a swollen smooth nucleus of about one whorl more; suture distinct, not appressed; surface smooth and polished, except for half a dozen spiral grooves on the canal; aperture narrow, the outer lip thickened with a slight varical swelling behind it; internally adults have about eight denticulations; body enameled, pillar also with a few obscure nodulations; canal short, slightly recurved; height of shell, 18; of last whorl, 10; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 59370.

Type-locality.—Cape San Lucas; W. H. Dall.

This species is more nearly related by its shell characters to Australian species like *Columbella interta* Gaskoin than to the usual West American types.

ALIA CASCIANA, new species.

Shell small, yellowish, acute, with a three-whorled smooth nucleus beginning with a very minute apex and five flattish subsequent whorls; suture distinct, minutely channeled; axial sculpture of faint incremental lines; spiral sculpture of very faint striae on the whorls behind the periphery, and a few stronger grooves near and on the canal; base subangular at the periphery, flattened in front; aperture narrow, simple, body slightly glazed, pillar short with a strong keel at its anterior border; canal short, deep,; height of shell, 9; of last whorl, 6; of aperture, 3.5; diameter, 4 mm. U. S. Nat. Mus. Cat. No. 209456.

Type-locality.—U. S. Fish Commission station 4322, off La Jolla, San Diego County, California, in 110 to 199 fathoms, shelly mud.

This species when fully adult probably has a few denticulations on the inside of the outer lip, and in fresh specimens the color may be variable. All those obtained at this station were "dead" shells.

ASTYRIS AMIANTIS, new species.

Shell small, pure white, solid, with seven moderately-rounded whorls exclusive of the (lost) nucleus; suture distinct, not appressed; axial sculpture of more or less evident incremental lines, sometimes so strong as to suggest riblets; spiral sculpture of fine threads, almost obsolete on most of the shell but coarser and more evident near the canal, covering the whole surface with narrower interspaces; aperture semilunate, outer lip simple, body erased, pillar very short, canal hardly differentiated; heigth of shell, 13; of last whorl, 8; of aperture, 4; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 221008.

Type-locality.—Beach at Kiska Harbor, Aleutians, station 1026; W. H. Dall.

? NITIDELLA LUTULENTA, new species.

Shell small, pale, with pale variations of brown or none, covered with a fibrous pale brownish periostracum; with about six whorls, including an extremely minute smooth nucleus; suture distinct, not appressed; surface of the whorls moderately convex; axial sculpture none but faint incremental lines; spiral sculpture only of a few spiral grooves on the back of the canal; aperture simple, the outer lip thin, not lirate within, body with a slight glaze, pillar thickened with an obvious keel on its anterior edge; canal short, wide; operculum normal; height of shell, 7; of last whorl, 5.5; diameter, 3.5 mm. U. S. Nat. Mus. Cat. No. 211068.

Type-locality.—U. S. Fish Commission station 3180, in the Gulf of the Farallones, off San Francisco, in 24 fathoms; bottom temperature, 50.7° F.

This may prove to be an *Alia*.

AMPHISSA VERSICOLOR, new variety INCISA.

Shell varicolored, acute, solid, with a thin brownish fibrous periostracum, with about eight whorls, including the smooth nucleus of about one whorl, the rest of the shell strongly sculptured; spiral sculpture of (on the spire about 6, on the last whorl about 16) strong, low, rounded, equal, and equally spaced cords, except one in front of the almost channeled suture, which is slightly more prominent than the others, separated by much narrower deep grooves; the spirals not nodulous when they cross the ribs; axial sculpture of (on the penultimate whorl about 14) obliquely protractive rounded ribs with subequal interspaces, somewhat obsolete near the aperture,

which is semilunate; outer lip hardly thickened, whitish, lirate within; body and pillar with a layer of whitish enamel; canal short, deep, slightly recurved; height of shell, 13.5; of last whorl, 10; of aperture, 6.5; diameter, 7 mm. U. S. Nat. Mus. Cat. No. 12285.

Type-locality.—Laguna Beach, California; Stearns collection. Differs from the typical *versicolor* by the strength of the sculpture, deep grooving, and generally by the duller color.

AESOPUS ARESTUS, new species.

Shell small, thin, slender, suffused with yellowish and white or ocellated somewhat like *Nitidella ocellata* with pale brown on a white ground, with six subcylindric whorls including a smooth swollen nucleus of about one whorl; suture distinct, not appressed; axial sculpture of numerous narrow nearly obsolete vertical riblets on the upper part of the spire, which are absent from the last whorl, except in the form of feeble vertical wrinkles; spiral sculpture none; aperture short, simple, outer lip thickened, not reflected, body with a layer of enamel, pillar lip thickened, slightly twisted, shorter than the outer lip; canal very short and deep; height of shell, 7; of last whorl, 3.8; diameter, 2 mm. U. S. Nat. Mus. Cat. No. 217928.

Type-locality.—Magdalena Bay, Lower California; collected by C. R. Orcutt.

MUREX (ALIPURPURA) RHYSSUS, new species.

Shell elongate, trialate, white, with a rasplike surface, a dark brown nucleus of two whorls, and five subsequent whorls, with a narrow shoulder in front of an obscure appressed suture; axial sculpture beside the three varices and the minute imbricate surface includes a nodulous rib between each pair of varices; the latter are slightly recurved with a prominent spinosity at the shoulder, about six major the same number of minor, and numerous smaller imbricate intercalary riblets in the last varix, which extends nearly to the end of the long closed canal; aperture ovate, white, simple, entire; operculum normal, brown; height of shell, 62; of last whorl, 47; of aperture, 12; maximum diameter, including the varix, 27 mm. U. S. Nat. Mus. Cat. No. 160500.

Type-locality.—San Pedro, California; collected by Mrs. Oldroyd.

PURPURA NUTTALLII Conrad, 1838.

There are two color varieties which seem worthy of distinction, one completely white or yellowish white, which may take the name of *P. nuttallii albescens*, and another, which, generally preserving the usual brownish color, has a broad white band, making it very conspicuous, about the middle of the shell, and one on the canal, which may be called *P. nuttallii albofasciata*. These color-varieties appear to be unusually constant and are found chiefly in the southern

range of the species from San Pedro, California, to Scammon Lagoon, Lower California. The specimens which may be regarded as types bear the museum catalogue numbers 252894 and 181827, respectively, and were collected by W. L. Chambers at San Pedro and by Henry Hemphill at San Diego, California.

TRITONALIA GRACILLIMA, new variety OBESA.

Tritonalia gracillima, var. *obesa* (Stearns MS.) in collection.

Shell resembling *T. gracillima* in most respects but notably wider. The coloration is yellowish, with brown flecks, especially on the prominences. The canal is closed. The aperture is bluish white, with four strong denticles on the anterior two-thirds of the inner lip. Height of shell, 19; of aperture and canal, 8; diameter, 7.5 mm. U. S. Nat. Mus. Cat. No. 228722.

Type-locality.—Laguna Beach, California; received from C. F. Baker.

TRITONALIA LURIDA Middendorff, new variety ROTUNDA.

Shell small, short, much inflated, solid, with four or more whorls, the apex eroded; suture appressed, obscure; axial sculpture incremental, irregular, sometimes rising to lamellae, forming pits in the interspaces of the spiral sculpture; the latter comprises (on the penultimate whorl 5 or 6, on the last whorl about 14) strong, elevated, blackish brown, more or less undulated and transversely striated squarish ribs with narrower interspaces, covering the whole whorl; aperture ovate, purplish when fresh, fading to light pink in the cabinet; outer lip strong, crenate by the sculpture, internally thickened and with six prominent denticles; inner lip erased, pillar short; canal very short, but distinctly recurved; height of shell, 16.5; of aperture, 12.5; diameter, 13 mm. U. S. Nat. Mus. Cat. No. 208495.

Type-locality.—Moss Beach, Halfmoon Bay, California; collected by F. L. Button.

TRITONALIA FUSCONOTATA, new species.

Shell solid, light yellow brown, with spiral bands of dark brown spots between the ribs, usually one at the periphery and another at each end of the whorl, but sometimes missing; whorls four or five exclusive of the (lost) nucleus, rather inflated; suture distinct, constricted, the whorl in front of it appressed and gathered into short, minute, vertical wrinkles; axial sculpture otherwise of six or seven prominent vertical ribs extending across the whorls and rather sharp elevated incremental lines; spiral sculpture of (on the last whorl about 24) subequal spiral cords with narrower channelled interspaces, covering the whorl; aperture rather wide, white; outer lip somewhat expanded, internally denticulate; body and pillar erased; canal short, closed in the adult, with a marked siphonal fasciole;

height of shell, 26; of last whorl, 20; diameter, 15 mm. U. S. Nat. Mus. Cat. No. 46729.

Type-locality.—Monterey, California, Stearns.

TRITONALIA CIRCUMTEXTA, new variety CITRICA.

This is a variety which, when fresh, presents a ground color of lemon or orange yellow instead of the usual grayish white, while the brown bands are much less emphatic and the shells are usually smaller than those of the type. Museum specimens, number 56747 from Catalina Island, may be regarded as the types.

TRITONALIA INTERFOSSA, new variety CLATHRATA.

This is a short and stout form with very prominent rectangular clathration and flatly turrited spire, which was distinguished by Dr. R. E. C. Stearns in manuscript many years ago but never published. The specimen from Avalon, Catalina Island, numbered 177995 in the museum series, may be taken as type. Height, 13; diameter, 7 mm.

TRITONALIA INTERFOSSA, new variety MINOR.

This is a pale dwarf, slender form, also from Catalina Island, number 56912, which seems nevertheless to have reached maturity. It is strongly clathrate and measures in height 7, and in diameter 3.5 mm.

TRITONALIA INTERFOSSA, new variety ATROPURPUREA.

This form resembles *clathrata*, but is more elongated and much less distinctly turrited. The color when fresh is a purplish black, which, however, fades in the cabinet to a more or less ruddy brown, after some years. It was discriminated in manuscript half a century ago by Dr. P. P. Carpenter, and has been sent out by that name to collectors, but so far as I know has not yet been published.

Specimens from Neeah Bay, Washington, numbered 155286 in the museum collection, may serve as types. Height, 19; diameter 7 mm.

TRITONALIA SCLERA, new species.

Shell of moderate size, yellowish, flushed with more or less dark brown, with six well-rounded whorls exclusive of the (lost) nucleus; suture obscure, undulated; axial sculpture of (on the last whorl 8, on the penultimate whorl 10) low inconspicuous rounded ribs extending more or less distinctly to the canal with continually wider interspaces; also low sharp incremental lines minutely imbricating the whole sculpture; spiral sculpture of (on the penultimate whorl about 7, on the last whorl about 25) strong prominent cords with wider interspaces usually showing an intercalary thread which on

the last whorl becomes nearly as strong as the others; aperture rounded, outer lip simple, periodically varicose; body crased, pillar straight; canal distinct, open, narrow, slightly recurved; height of shell, 29; of last whorl, 21.5; of aperture and canal, 15; diameter, 16 mm. U. S. Nat. Mus. Cat. No. 222569.

Type-locality.—U. S. Fish Commission station 4205, near Port Townsend, Washington; in 20 fathoms, hard bottom; temperature, 50.8° F.

The operculum is purpuroid and dark brown.

TRITONALIA EPIPHANEA, new species.

Shell small, dark brown, acute, with an angular shoulder, slender, with six whorls exclusive of the (lost) nucleus; suture distinct, slightly wrinkled and more or less appressed; spiral sculpture of (on the penultimate whorl six above and seven below the shoulder) strong equal threads with narrower interspaces, the whole slightly imbricated and covering the entire surface in a regular manner; axial sculpture of (on the last whorl seven) strong rounded ribs most prominent at the shoulder and with much wider interspaces, the spire deeply constricted at the suture; aperture oval, the outer lip thickened but not reflected, internally white with six equal and equally spaced denticulations, the body and arcuate short pillar with a layer of white enamel; the canal long, closed near the aperture, with a narrow fasciole and slightly recurved; height of shell, 25; of last whorl, 18; of aperture and canal, 13; diameter, 11 mm. U. S. Nat. Mus. Cat. No. 216809.

Type-locality.—San Pedro, California, collected by Dr. Tremper.

TRITONALIA TRACHEIA, new species.

Shell small, solid, rough, of a greenish gray color, of about five strongly shouldered whorls, the nucleus lost; the suture obscure, not appressed; axial sculpture of (on the penultimate whorl 9, on the last whorl 6 or 7) strong ribs, subspinose at the shoulder, and extending to the base; beside these there are rude incremental lines; spiral sculpture on the spire of two strong cords at the periphery, nodulous where they cross the ribs; on the last whorl below the periphery there are three strong cords with narrower deep interspaces, then a wider gap and two more on the canal; aperture subcircular, dark green, with an entire simple margin, the operculum muricoid; canal short, solidly closed, straight, with an imbricate siphonal fasciole; height of shell, 11.5; of last whorl, 8; diameter, 8 mm. U. S. Nat. Mus. Cat. No. 207084.

Type-locality.—Sitka, Alaska, in 15 fathoms, mud, dredged by W. H. Dall.

TRITONALIA TURRITA, new species.

Shell large, solid, short in proportion to its width, of four or more whorls, the apex defective; white with strong brown spiral cords: suture strongly appressed, with a whitish band in front of it, undulated by the ribs; axial sculpture of eight strong short ribs beginning at the shoulder and extending over the periphery, but stronger at the shoulder, the whorl being somewhat constricted behind them; spiral sculpture of (on the last whorl nine) strong, dark brown spiral cords, undulated by the ribs and minutely lamellose: there may be also some lesser intercalary threads; aperture rounded, outer lip much thickened, internally white with half a dozen denticulations within; inner lip white, concavely arcuate, erased: pillar short, thick; canal short, open, slightly recurved, with an obvious fasciole. Height of shell (decollate), 34; of last whorl, 28; of aperture, 20; diameter at decollation, 4; maximum diameter, 21 mm. U. S. Nat. Mus. Cat. No. 34517.

Type-locality.—San Quentin Bay, Lower California; collected by L. Belding.

Though the specimens are worn this is clearly distinct from the known species. The late Dr. R. E. C. Stearns proposed the above name but never described the shell.

Genus TROMINA Dall, 1918.

This name was proposed for the curious little shell from the Magellanic region named in 1868, by Philippi, *Fusus unicarinatus*. This has the nucleus of a *Trophon* and is probably related to the austral Trophons, but the soft parts are not known. It is more fully discussed in my paper of 1902.[1]

Genus NEPTUNEA (Bolten) Dall, 1902.

I showed in 1902 [2] while discussing the synonymy of the genus *Chrysodomus* that the latter genus was named and a type designated many years before anyone attempted to restrict and name a type for the heterogeneous collection included under the name *Neptunea* by Bolten. Herrmannsen, in 1847, correctly indicated *Trophon* (in the wide sense of that day) as the equivalent of *Neptunea* but named no type. Typical *Trophon* had been segregated by Montfort in 1810, the only other *Trophon* in Bolten's list is the type of Sars' *Boreotrophon* (*clathrus*) 1878. It is therefore obvious that *Neptunea* must be restricted to the boreal Trophons and Sars's name be relegated to synonymy, as I showed by the method of elimination in 1902.

[1] Proc. U. S. Nat. Mus., vol. 24, No. 1264, p. 536, March, 1902.
[2] Idem, pp. 520-521.

NEPTUNEA TOLOMIA, new species.

Shell small, short, inflated, white, with an angular shoulder near the periphery on the spire, with more than four whorls (the apex defective), the suture distinct, not appressed; axial sculpture of (on the last whorl about 35) sharp ribs, regularly spaced, with wider interspaces, extending from the suture over the base; these ribs only become lamellose with senility; the canal is axially striated and the incremental lines visible; on the upper spire the intersection of the ribs and shoulder angle tends to become nodulous; aperture rounded, simple, body erased, canal narrow, a little recurved; height of shell, 19; of last whorl, 15; of aperture, 10; diameter, 10 mm. U. S. Nat. Mus. Cat. No. 222441.

Type-locality. —U. S. Fish Commission station 2896, off San Miguel Island, California, in 376 fathoms, mud; bottom temperature, 43° F.

NEPTUNEA APOLYONIS, new species.

Shell small, white, subturrited, with more than four whorls, the apex eroded, the suture distinct; axial sculpture of (on the last whorl 13 to 15) sharp low varices with wider interspaces, sometimes feebly angular at the shoulder on the spire but on the last whorl the angle is blunted or obsolete; there is no spiral sculpture and the incremental lines are not conspicuous; aperture rather wide, ovate white, the outer lip reflected at the varices; body and pillar with a coat of white enamel; canal narrow, slightly recurved, rather long; the base of the last whorl gently constricted. Height of three whorls, 21; of last whorl, 17; diameter, 10 mm. U. S. Nat. Mus. Cat. No. 209303.

Type-locality.—U. S. Bureau of Fisheries station 4423, in the vicinity of the Santa Barbara Islands, California, in 216 to 339 fathoms, sand.

This is much like *N. tolomia* in general form but has fewer varices and no spiral cords.

NEPTUNEA ITHITOMA, new species.

Shell elongated, slender, acute, with a yellowish tinge, with eleven varices, spinose at the shoulder, with five or more whorls, the apex decorticated; suture distinct, more or less undulated by the sculpture; the varices sharp and imbricating; sculpture only of obvious incremental lines and here and there a minute vermiculation; aperture elongate-oval, outer lip thin, sharp; body erased; pillar arcuate, twisted; canal long, narrow, curved; height of shell, 38; of last whorl, 29; of aperture and canal, 25; diameter, 16 mm. U. S. Nat. Mus. Cat. No. 222623.

Type-locality.—U. S. Fish Commission station 4255, in Taiya inlet, southeastern Alaska, in 253 fathoms, rocky bottom; temperature, 36.8° F.

The operculum is dark brown and normal.

NEPTUNEA STAPHYLINA, new species.

Shell white, slender, subturrited, of five or more whorls, the apex lost; suture distinct; axial sculpture of (on the last whorl seven) sharp-edged varices, prominent only at the shoulder where they are produced into a small spine; there is no spiral sculpture except the angle at the shoulder; aperture obovate, simple; canal long, narrow, recurved; the body with a coat of enamel, the pillar very short; operculum normal; height of spire, 9; of aperture, excluding the canal, 5.5; the canal, 6.5; diameter, 8 mm. U. S. Nat. Mus. Cat. No. 209947.

Type-locality.—U. S. Fish Commission station 4415, off Santa Barbara Island, California, in 302 to 638 fathoms, mud.

NEPTUNEA CALLICERATA, new species.

Shell small, white, with a smooth nucleus of one and a half whorls and five subsequent whorls; suture distinct, not appressed; varices sharp, a spine rising nearly vertically from the shoulder, guttered and slightly recurved, nine on the penultimate, eight on the last whorl, and extending from the suture to the base; spiral sculpture of extremely close fine striation on the whorls above the base and in front of the shoulder; aperture semilunate, body erased, pillar long and attenuated; canal long, slender, slightly curved; height of shell, 16; of last whorl, 12; of aperture and canal, 9; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 209914.

Type-locality.—U. S. Fish Commission station 4356, off Point Loma, California, in 120 to 131 fathoms, muddy bottom.

NEPTUNEA (TROPHONOPSIS) LASIA, new species.

Shell fusiform, slender, white, with a dingy brownish periostracum and more than five whorls, the apex defective; suture distinct, the whorls prominently rounded; axial sculpture of numerous elevated incremental lines which imbricate or nodulate the spiral sculpture at their intersections; spiral sculpture of (on the early whorls 4, on the penultimate whorl by intercalation 8, on the last whorl about 25) narrow cords with wider or subequal interspaces, increasing by intercalation until on the last whorl they become practically equal and mostly minutely imbricated; aperture ovate; outer lip thin, simple; body erased; canal long, narrow, recurved; axis minutely pervious, pillar short, gyrate; height of shell, 30; of last whorl, 24; of aperture and canal, 19; diameter, 10.5 mm. Operculum normal. U. S. Nat. Mus. Cat. No. 210087.

Type-locality.—U. S. Fish Commission station 4515, off Point Pinos, California, in 198 to 495 fathoms mud and shell.

This is closely related to *N. tenuisculpta* Carpenter.

TYPHIS LATIPENNIS, new species.

Shell large for the genus, solid, heavy, with four varices to a whorl, the tubes retractive, nearer the preceding varix, and about six whorls, the nucleus rounded, small; suture obscure, the spaces between it and the shoulder excavated; sculpture of a keel at the shoulder and lines of growth elsewhere; terminal varix wide, with a prominent retractive spine at the shoulder and the outer edge recurved; aperture ovate, entire, canal (defective) closed, not very long; height of shell (estimated), 30; of spire, 8; of aperture, 7; maximum diameter, 24 mm. U. S. Nat. Mus. Cat. No. 96653.

Type-locality.—U. S. Fish Commission station 2822, off Lower California, in 21 fathoms, sand.

Although the specimen is defective about the end of the canal, it is obviously distinct from either of the species yet described from this region.

CORALLIOPHILA STEARNSIANA, new species.

Shell large, solid, white, of about six very rapidly enlarging whorls, with an acute apex, the nucleus decorticated; suture distinct, very deep and narrow, but not channelled; axial sculpture of about 16 rounded ribs with subequal interspaces, chiefly prominent on the periphery, much obscured by the spiral sculpture and obsolete on the last half of the last whorl; spiral sculpture of (on the last whorl) in front of the suture about 15 close-set small cords not undulated by the ribs, next follow 10 or more much coarser ribs of irregular prominence with subequal interspaces carrying each an intercalary thread, all with the rasp-like lamination peculiar to the genus and extending to the verge of a narrow, axially striated umbilicus; aperture wide, rounded, the outer lip simple, the body with a lamina of white enamel, the pillar lip short, with a *Trichotropis*-like notch at its base; height of shell, 23; of last whorl, 18; of aperture, 15; diameter, 24 mm. U. S. Nat. Mus. Cat. No. 46377.

Type-locality.—Lower California; Stearns Collection.

CORALLIOPHILA (PSEUDOMUREX) KINCAIDI, new species.

Shell fusiform, dirty white, with about six shouldered whorls, the nucleus decorticated, the suture deep, very narrow; axial sculpture of nine rather sharp vertical ribs extending from the suture to the canal with wider interspaces; spiral sculpture of (on the penultimate whorl eight) strong subequal cords, with narrower deep interspaces covering the whole shell, all furnished densely with short guttered lamination as usual in the genus; aperture ovate, outer lip simple,

fringed by the external sculpture, inner lip glazed with white enamel; canal rather long, bent to the left, narrow, open, with a strong laminose fasciole; height of shell, 30; of last whorl, 21; diameter, 15 mm. U. S. Nat. Mus. Cat. No. 183067.

Type-locality.—Puget Sound, Prof. Trevor Kincaid. This has somewhat the aspect of a *Tritonalia*.

CORALLIOPHILA (PSEUDOMUREX) ORCUTTIANA, new species.

Shell white with a pinkish flush in the aperture, of about six whorls, the nucleus defective, suture distinct, slightly appressed; axial sculpture of (on the last whorl 10) vertical rounded ribs extending to the canal, with equal or narrower interspaces and overrun by the spirals; spiral sculpture on the penultimate whorl of one strong peripheral cord, a secondary smaller cord on each side of it, carrying a smaller thread in the interspaces; between the suture behind and the first secondary cord are three threads and this part of the whorl is slightly flattened; on the last whorl beside the peripheral one there are about a dozen secondary cords and as many intercalary threads, all sculptured with small close-set arched lamellae; aperture rather small, outer lip striated within at certain stages, inner lip with rosy white enamel; canal long, narrow, with a well marked fasciole; height of shell, 22; of last whorl, 17; of aperture and canal, 13; diameter, 11 mm. U. S. Nat. Mus. Cat. No. 217869.

Type-locality.—Magdalena Bay, Lower California; C. R. Orcutt.

EPITONIUM (ASPEROSCALA) TINCTORIUM, new species.

Shell small, white with a narrow purple-brown spiral line in front of the suture, of six or more whorls excluding the (lost) nucleus; the whorls adjacent, the axis imperforate, with 11 to 12 continuous varices which about half encircle the spire; the varices smooth, slightly reflected, wider where they cross the rather deep suture; there are no varical angles or spines; the whorls are uniformly finely spirally striated; aperture rounded; there is no basal cord or disk; no operculum was taken with the specimen; height of shell, 7; of last whorl, 3; diameter, 3 mm. U. S. Nat. Mus. Cat. No. 218100.

Type-locality.—Magdalena Bay, Lower California; collected by C. R. Orcutt. The colored line probably fades in time in the cabinet, like that of the Californian *tincta* Carpenter, which is a larger shell.

EPITONIUM (ASPEROSCALA) KERATIUM, new species.

Shell small, white, with 13 or 14 varices and 8 rounded whorls exclusive of the (lost) nucleus; suture distinct, axis imperforate; varices concentrically striated on the anterior face, not coronate or angular, continuous up the spire, which they about one-third encircle; spiral sculpture of, on the early whorls, fine close threads, which gradually

become feeble and on the last whorl entirely absent; aperture rounded with a slight angulosity at the anterior end of the pillar lip, forming a strong wrinkled fasciole behind that lip; there is no basal disk or ring; height, 10; diameter, 4.5 mm. U. S. Nat. Mus. Cat. No. 217878.

Type-locality.—Magdalena Bay, Lower California; collected by C. R. Orcutt.

EPITONIUM (ASPEROSCALA) CANNA, new species.

Shell small, white, shading to yellowish on the spire, with six whorls excluding the (lost) nucleus, imperforate, with a deep suture and six strong varices, continuous up the spire which they about one-fourth encircle; the varices are concentrically striated on the anterior face, are very solid, and have no angulation at the shoulder; spiral sculpture of on the base of the last whorl numerous minute sharp threads with intercalary fine striae occupying the wider interspaces; this sculpture becomes obsolete at or behind the periphery; there is no basal cord or disk; height, 9; maximum diameter, 5 mm. U. S. Nat. Mus. Cat. No. 218099.

Type-locality.—Magdalena Bay, Lower California; collected by C. R. Orcutt.

EPITONIUM (NITIDOSCALA) BARBARINUM, new species.

Shell small, imperforate, white, with 11 varices continuous up the spire which they one-third encircle; anterior surface of the varices flattish, smooth; the shoulder is not angular or spinose; there are six whorls exclusive of the (lost) nucleus; suture deep; base rounded without a basal cord or disk; aperture subovate, the inner lip thickened; height of shell, 19; of last whorl, 7.5; of aperture, 4; diameter, 6.5 mm. U. S. Nat. Mus. Cat. No. 46229.

Type-locality.—San Diego, California, Stearns collection.

EPITONIUM (NITIDOSCALA) PHANIUM, new species.

Shell small, white with a flesh-colored upper spire, with seven or eight nearly vertical continuous varices, and somewhat more than eight whorls, including a smooth white nucleus of two whorls; suture distinct, deep; axis imperforate; surface smooth except for faint incremental lines, the varices smooth without angles or spines; base rounded with no basal disk or cord; aperture oval, simple; height of shell, 8; of last whorl, 4; of aperture, 1.5; diameter, 3 mm. U. S. Nat. Mus. Cat. No. 218095.

Type-locality.—Magdalena Bay, Lower California; collected by C. R. Orcutt.

EPITONIUM (NITIDOSCALA) CALLIPEPLUM, new species.

Shell small, lilac color on the spire, paling into white on the last whorl, with about eight whorls exclusive of the (lost) nucleus, imper-

forate; suture deep; axial sculpture of very faint incremental lines and 11 thin, low, narrow, continuous varices, dipping into the suture which encircle less than a quarter of the circumference of the spire; surface polished, aperture obliquely ovate; height of shell, 9; of last whorl, 5; diameter, 4 mm. U. S. Nat. Mus. Cat. No. 218096.

Type-locality.—Beach at Magdalena Bay, Lower California; collected by C. R. Orcutt.

GRAPHIS SHEPARDIANA, new species.

Shell minute, slender, translucent yellowish, with about nine whorls, including the rather blunt smooth apical nucleus; suture constricted, distinct, coils of the spire rather lax; axial sculpture of minute, close-set plications which start from the suture and become feeble on the base; these are crossed by minute close spiral striae most evident near the periphery, and under the lens showing an inconspicuous reticulation; base imperforate, rounded, and somewhat produced; aperture ovate, the margin thin, not reflected, interrupted by the body, produced anteriorly; height of shell, 3.7; diameter, 1 mm. U. S. Nat. Mus. Cat. No. 107276.

Type-locality.—San Pedro, California; collected by Miss Ida Shepard, now Mrs. Oldroyd.

This shell was collected and named in 1895, but by some accident the diagnosis has remained unpublished. It may have been distributed under the generic name of *Stylopsis*.

CARINARIA LATIDENS, new species.

Animal slender and mostly translucent yellowish; the extreme tail for a short distance, the muzzle, and the liver contained chiefly in the shell, are dark purple; the crop or anterior food cavity is pinkish; the eyes very vivid black, contained in short subcylindric processes behind and a little outside of the short slender tentacles. The surface of the body is covered with small translucent acute pustules. The gills are small and protrude from the shell. The ventral fin is rounded quadrate, about one-third of the way from the muzzle to the tail. The shell and its included organs are about midway of the total length. The ventral sucker is small on the ventral and near the posterior edge of the fin. The dorsal fin halfway between the shell and the tail is lower, rounded triangular, diminishing in height backwards. The shell is small, with a minutely coiled apex, and the weight of the included organs causes the animal to swim permanently on its back. The radula is of the general type of that of *C. cristata*, but the rhachidian tooth is more than twice as wide proportionately and develops a small cusp at each anterior corner of the base a feature not known in *C. cristata*. There are three slender laterals. Behind the eyes the body is gradually constricted

forming a sort of neck. The specimen (which was figured from life) was about 150 mm. in length; its greatest diameter just behind the ventral fin about 22 mm.

Collected on the surface of the North Pacific Ocean in latitude 43° 10′ north, and longitude 147° west, by W. H. Dall, July 23, 1866.

SEGUENZIA CERTOMA, new species.

Shell small, trochiform, white, with a minute, smooth globular nucleus and seven subsequent strongly sculptured whorls; suture obscure: spiral sculpture of a small, closely beaded thread at the summit of the whorl, separated from a low, sharp carina by a wider, excavated interspace, and the latter from a more prominent peripheral carina by a still wider space; on the base are three sharp threads followed by three lower rounded threads, which approach the pillar; axial sculpture of fine, even, arcuate wrinkles, which, except where they bead the posterior thread, are chiefly visible in the interspaces; the suture is laid on the peripheral thread and between it and the outer lip at the aperture is a very deep sulcus; the outer lip is much produced and its edge modified by the external sculpture, so that there is a sulcus at the end of the peripheral keel, another at the middle of the base, and still another at the base of the pillar, which is arcuate and produced like a small plait; the base is imperforate, the body with no visible glaze; height, 5; diameter, 3.5 mm. U. S. Nat. Mus. Cat. No. 211167.

Type-locality.—U. S. Fish Commission station 4337, off Point Loma, California, in 565 to 680 fathoms, mud and gravel.

SEGUENZIA GIOVIA, new species.

Shell resembling the preceding species, but larger and differently sculptured; nucleus minute, smooth, subglobular followed by seven sculptured whorls; suture obscure, laid on the peripheral keel; spiral sculpture of four narrow prominent keels, of which the second is peripheral, the third marginates the base, and the fourth is on the base, the interspaces much wider and becoming narrower anteriorly; there are also seven closer even low threads on the base with subequal interspaces; the posterior wide interspaces are sculptured with close-set fine spiral threads; axial sculpture of numerous equal and equally spaced arcuate threads, with wide interspaces, which on the upper whorls bead the posterior carina, but later are chiefly visible in the interspaces and extend over the whole shell; the sulcus at the aperture next the body is shallow, the outer lip beyond it moderately produced and crenulate by the sculpture, the thin and arcuate pillar has a very small notch at its base, and there is a deep twisted perforate umbilicus and a thin layer of enamel on the body; height, 6; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 209228.

Type-locality.—U. S. Fish Commission station 4408, off Catalina Island, California, in 104 to 118 fathoms, sand.

SEGUENZIA CERVOLA, new species.

Shell small, white, slightly depressed, with one small, smooth nuclear whorl and five subsequent whorls flattened a little in front of a distinct suture, separated by a somewhat convex smooth fasciole from a thread-like keel above the periphery; in front of this is a wide, smooth interval; on the base are about a dozen spiral threads with wider interspaces, and very faint microscopic spiral striae are visible in all the interspaces under a lens; on the upper whorls there is a small thread between the keel and the suture, and near the apex they become obsolete; at the aperture is a shallow sulcus between the keel and the suture and a smaller one at the middle of the base; there is a sharp notch below the end of the thin, arcuate projecting pillar, behind which is a moderately large twisted umbilicus; the body shows no glaze, the base of the shell is conspicuously convex; height, 4.5; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 209229.

Type-locality.—U. S. Fish Commission station 4381, off North Coronado Island, in 618 to 692 fathoms.

SEGUENZIA CALIANA, new species.

Shell small, white, elevated, trochiform, with a minute glassy smooth nucleus and about five subsequent whorls; suture obscure, laid on the peripheral keel; spiral sculpture of, on the spire a single sharp prominent keel somewhat behind the central line between the sutures, and on the last whorl a similar peripheral keel with a wide excavated space on each side of it, the space behind the periphery wider; base with seven rather close-set squarish cords, those nearer the axis most adjacent to each other; axial sculpture of low thin sharp lamellae with wider interspaces, over riding the peripheral keel on the spire but not on the last whorl, prominent in the interspaces behind the base, retractively arcuate in the posterior interspace, and protractively arcuate in the others; they do not invade the somewhat flattish base; aperture with a very deep sulcus next the suture, the outer lip in front of it much produced, a feeble sulcus at the middle of the base, in front of the arcuate pillar a smaller rounded indentation; behind the pillar a deep groove ending in a minutely perforate umbilicus; body with no perceptible glaze; height of shell, 4.5; diameter, 3.2 mm. U. S. Nat. Mus. Cat. No. 207694.

Type-locality.—U. S. Fish Commission station 2928, off San Diego, California, in 417 fathoms sand and gravel; bottom temperature, 41° F. Also in more than 800 fathoms.

? CERITHIOPSIS SASSETTA, new species.

Shell small, slender, white with a pale olive periostracum, with more than seven whorls, the apex being eroded, the whorls moder-

ately rounded, the suture distinct, not appressed; spiral sculpture of (on the spire four, on the last whorl five) equal and equally spaced rounded cords with more or less intercalary minute threading, on the early whorls; the anterior pair of cords are somewhat more prominent than the others; the base is disk-like, flattish, with six or more feeble spiral threads between the carinate margin and the imperforate axis; axial sculpture of (on the penultimate whorl about 17) rounded retractively arcuate riblets, with wider interspaces somewhat nodulous at intersections with the spiral cords, and becoming obsolete on the last whorl, on the spire they extend from suture to suture and on the last whorl to the base; there is also irregular incremental threading; aperture ovate, lips simple, sharp, a shallow sulcus next the anterior end of the pillar lip; height, 6.5; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 271062.

Type-locality.—U. S. Fish Commission station 4555, off Point Pinos, Monterey Bay, California, in 66 to 69 fathoms, green mud.

? ALABINA CALENA, new species.

Shell small, with a very pale olivaceous periostracum, acute, slender, with about eight rounded whorls, the apex eroded; suture distinct, deep, marked by a small thread against which it is laid; spiral sculpture of (on the spire three) flattish cords with subequal channeled interspaces, on the last whorl four, the third at the periphery largest; axial sculpture on the upper spire of obscure radials which undulate the cords but do not show in the interspaces, and later are obsolete; there are also very fine silky regular incremental lines; the base is discoid, slightly flattish, imperforate, the aperture ovate, simple, the outer lip thin sharp, the inner lip white, glazed; the pillar short, thick, and attenuated, the lip beyond it produced, patulous; height, 10; diameter, 4 mm. U. S. Nat. Mus. Cat. No. 271070.

Type-locality.—U. S. Fish Commission station 3195, off San Luis, Obispo Bay, in 252 fathoms, mud; bottom temperature, 43.2° F.

? STYLIDIUM PAGANICUM, new species.

Shell small, slender, dark reddish brown, more or less divided by paler spiral lines on the later whorls; smooth except for incremental lines, with more than six rather flattish whorls, the apex in every case eroded; suture distinct, not deep; base rounded, imperforate, the aperture ovate, the outer lip thin sharp, somewhat arcuate and produced anteriorly, inner lip erased, pillar lip slightly twisted, not thickened; operculum paucispiral; height, 8; diameter at truncation, 1.5; at base, 3 mm. U. S. Nat. Mus. Cat. No. 271078.

Type-locality.—U. S. Fish Commission station 4508, 9 miles off Point Pinos, Monterey Bay, California, in 292 to 356 fathoms, mud.

The lineate painting often shows through the shell at the inside of the aperture.

PIRENELLA CYCLUS, new species.

Shell small, white mottled with brown, probably darker when fresh, with six flattish whorls (excluding the lost nucleus) separated by a rather obscure suture; spiral sculpture of (on the spire and the upper half of the last whorl three) rows of prominent hemispherical nodules, with subequal interspaces; on the lower half of the last whorl, four undulated or obscurely nodulose flattish cords with narrower interspaces; beside these there is fine spiral threading over the surface and in the interspaces; the nodules are arranged in vertical lines above one another and give the effect of ribs, but the ribs if any are very feeble and hardly perceptible in the interspaces; base rounded, aperture rounded, the outer lip slightly thickened, not internally lirate; body and pillar with a thick coat of enamel, pillar shorter than the aperture, with a sharp siphonal sulcus behind it. Height of shell, 6.5; of last whorl, 3.5; diameter, 3.5 mm. U. S. Nat. Mus. Cat. No. 215572.

Type-locality.—Laguna Beach, California; Mrs. Ball.

CLAVA CALIFORNICA, new species.

Shell conic, slightly turrited, white with brown maculation on the spirals, or all brown, with more than six whorls (the apex defective) separated by an obscure more or less undulated suture; spiral sculpture on the spire of one strong beaded band in front of the suture and two subequal smaller ones in front of that, with narrower channeled interspaces, a narrow groove on each side of the floor of the interspace; on the rounded base are seven narrow grooves with wide flattish interspaces; last whorl suddenly enlarged with a strong rounded varix above the pillar and at the outer lip; aperture oblique, produced at the posterior commissure into a sort of channel; pillar very short, canal narrow, deep; the axis has a single sharp plait, hardly visible in the aperture but continuous up the spire, in addition to the sharp edge of the pillar; height of shell (six whorls), 28; of last whorl, 14; diameter, 13 mm. U. S. Nat. Mus. Cat. No. 264899.

Type-locality.—South end Tiburon Island, Gulf of California; Dr. Paul Bartsch. This is the first record of the genus on the west coast.

TACHYRHYNCHUS EROSUS, new variety MAJOR.

Shell resembling *T. erosus*, but much larger and coarser, of eight or more whorls, the apex as usual much eroded; suture almost appressed, rather obscure; spiral sculpture of (between periphery and suture five) channeled grooves with low flattish wider interspaces; on the flattish base there are four more, closer and diminishing toward the axis; aperture rounded, outer lip thin, deeply widely, retractively arcuate, inner lip with a glaze of enamel, pillar lip slightly thickened and at the anterior end a little produced; the interior of the aperture

is smooth and there is no umbilicus. Height of (decollate) shell, 35; of last whorl, 14; diameter, 13 mm. U. S. Nat. Mus. Cat. No. 224134.

Type-locality.—U. S. Fish Commission station 3253, off the Pribilof Islands, Bering Sea, in 51 fathoms, mud; bottom temperature, 39.5° F.

? TACHYRHYNCHUS PRATOMUS, new species.

Shell small, yellowish white, acute, with a glassy swollen nucleus of about one whorl and six subsequent whorls; suture distinct, not deep, axis imperforate; early whorls moderately convex, the periphery nearer the succeeding suture, with numerous low rounded rather irregular ribs extending from suture to suture, with subequal interspaces; these ribs become gradually obsolete on the later whorls; spiral sculpture of low, irregularly distributed partially obsolete threads, with minute threadlets between them, this sculpture covers the entire whorl; base convexly regularly rounded with no umbilical depression; aperture ovate, simple, the lips sharp, with no callosities on the body; height, 10; diameter, 4mm. U. S. Nat. Mus. Cat. No. 219369.

Type-locality.—Semidi Islands, Alaska, at station 1152, in 20 fathoms, gravel, collected by W. H. Dall.

This is obviously not a typical *Tachyrhynchus*, but in the absence of the operculum and soft parts I am unwilling to refer it to a new group. It may be related to the New England *Couthouyella* or to *Bittium*.

? TACHYRHYNCHUS STEARNSII, new species.

Shell small, slender, acute, white or pale brownish, with a minute subglobular mucleus and about 10 subsequent well-rounded whorls, regularly increasing in size; suture distinct, not appressed; spiral sculpture of (on the spire three, on the last whorl four) low prominent lines about equally spaced above the base, and minute almost microscopic close-set spirals in the interspaces and on the convexly rounded base; axial sculpture not perceptible; aperture rounded, simple, the outer lip somewhat arcuate, the body thinly glazed; height of shell, 13; diameter, 4.5 mm. U. S. Nat. Mus. Cat. No. 74014.

Type-locality.—San Pedro, California, Stearns Collection.

This was regarded as a new species of *Mesalia* by Doctor Carpenter, but I have always had some (perhaps unwarranted) suspicion that the shell is exotic.

TURRITELLOPSIS (ACICULA variety) STIMPSONI, new name.

Turritellopsis acicula G. O. SARS, Moll. Reg. Arct. Norv., p. 186, pl. 10, fig. 14 *a—b.*; pl. 7, fig. 2 *a—e*; pl. 18, fig. 25, 1878; not of Stimpson, Shells of New England, p. 35, pl. 1, fig. 5, 1851.

A comparison of the figures of Stimpson and Sars, both elegant and accurate draftsmen, shows at once that there is a wide difference between them. *T. acicula* is more slender. with a looser coil and

a much more constricted suture. It has three strong spiral cords while *T. stimpsoni* has five to seven. The west coast specimens so far obtained are of the *stimpsoni* type, which is represented in the Jeffreys collection from Lofoten, Spitsbergen, and Maine. The original *acicula* type from Grand Manan; Portland, Maine; and Newfoundland. On the Pacific side we have the *stimpsoni* from Nunivak Island; Port Etches; Shoal Bay, British Columbia and San Diego, California.

? EGLISIA NEBULOSA, new species.

Shell with the apex and outer lip defective, about seven whorls remaining, white with yellowish brown clouding, whorls regularly increasing, well rounded, with a rather constricted suture; spiral sculpture of (on the last whorl four) small threads with narrower interspaces, in front of which are six stronger threads with at the periphery an intercalary threadlet; behind the margin of the base on the last remaining whorl there is a constriction, the margin being formed by a stout cord on which the suture is laid; the base is flattish with spiral sculpture obsolete or absent; axial sculpture of very low thin sharp varices crossing the whorl and inconspicuous incremental lines; base imperforate, aperture rounded. Height of seven whorls, 18; of last whorl, 8; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 120702.

Type-locality.—Cape San Lucas, Lower California.

This was pronounced to be a new species of *Eglisia* by the late Doctor Carpenter, but it lacks the channel in front of the suture in the typical species. It looks as if it were related to *Epitonium*, and from Edgar Smith's discussion of the genus I have no doubt it belongs to that family.

Genus LITTORINA Ferussac, 1822.

Type, *L. littoralis* Linnaeus.

Section ALGARODA Dall, 1918.

Type, *L. litorea* Linnaeus.

Section LITTORIVAGA Dall, 1918.

Type, *L. sitchana* Philippi.

Subgenus MELARAPHE (Mühlfeldt) Menke, 1828.

Type, *L. neritoides* Linnaeus.

Subgenus ALGAMORDA Dall, 1918.

Type, *A. newcombiana* Hemphill.

LACUNA MARMORATA, new species.

Shell small, short, acute, dark brown (fading in the cabinet) of three or four rapidly enlarging whorls; suture distinct; surface, when un-

worn, with a fine spiral striation which is sometimes feeble; the last whorl has a marked keel at the margin of the base in most specimens, but this region is frequently more or less rounded, and is generally whitish with interrupted brown flecks, which painting occasionally spreads over the upper part of the whorl; a white band in front of the suture is common and on the base the white may be extended to a brown area bordering the umbilicus; height, 6; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 47081.

Type-locality.—Monterey, California.

A variety is more elevated and acute, with a more pronounced keel and narrower umbilical groove, which may take the new varietal name of *olla*. U. S. Nat. Mus. Cat. No. 216895.

Type-locality.—Olga, Washington.

This was formerly known to collectors on the Pacific coast as *Lacuna unifasciata* Carpenter, but the type-specimens of the latter in the United States National Museum (Cat. No. 60675) are more acute, elevated, and slender, pale above and below with a continuous dark brown line at the keel; exactly the reverse of the present species, which, when fresh, is dark above with a white or whitish line at the keel, broken up by brown dots or flecks.

LACUNA, new variety PUTEOLOIDES (Carpenter MS.).

This form is represented in the collection by specimens from Lobitas, California, collected by Doctor Stearns and labeled by Doctor Carpenter (No. 46984). The only difference between it and the typical *L. porrecta*, to which Doctor Carpenter allied it as a variety, appears to be a considerably narrower pillar and consequently sharper and narrower umbilical groove in the variety. As far as I am able to discover Doctor Carpenter did not publish the name.

Genus BOETICA Dall, 1918.

Shell small, solid, subconic, few whorled, umbilicate, a groove at the commissure of the outer lip and body, a shallow sulcus at the anterior end of the pillar lip, the aperture without denticulation, the lip not reflected.

Type.—*Boetica vaginata* Dall.

BOETICA VAGINATA Dall, 1918.

Shell small, solid, conical, white, smooth except for faint incremental lines, of about five rapidly enlarging whorls including a minute subglobular smooth nucleus; suture distinct, not deep; base rounded, aperture subovate, a distinct sharp groove in the subsutural callus, the outer lip simple, thick; the body with a thick coat of enamel curving into the concavely arcuate pillar lip; umbilicus perforate, the area bounded by a thickened spirally striated ridge parallel with the

pillar lip, with the area between them excavated; at the anterior end of the pillar is a shallow, narrow sulcus, somewhat as in *Trichotropis;* height of shell, 4; of last whorl, 3; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 209891*a*.

Type-locality.—U. S. Fish Commission station 4322, off La Jolla, San Diego County, California, in 199 fathoms, shelly mud.

The exact position of this genus awaits the discovery of the operculum and soft parts.

HALOCONCHA MINOR, new species.

Shell small, purple-brownish, trochiform, with about three and a half rounded, rapidly enlarging whorls including a minute glassy nucleus; surface smooth except for incremental lines, covered with a glossy olivaceous translucent periostracum; suture distinct and deep; base rounded with a moderately wide umbilicus; aperture ovate, body with a layer of enamel connecting the two lips; height, 5.5; longer diameter, 6; shorter diameter, 5 mm. U. S. Nat. Mus. Cat. No. 215073.

Type-locality.—English Bay, St. Paul Island, Pribilof group in Bering Sea, in the laminarian zone. Collected by G. D. Hanna and various others.

This resembles *Haloconcha reflexa* Dall, of the same region, but is uniformly smaller. That species seems confined to the Pribilof Islands, but *H. minor* ranges also through the Aleutian chain and eastward as far as Chirikoff Island.

FOSSARUS ANGIOLUS, new species.

Shell small, yellowish white, with a minute globular nucleus and about four whorls; the suture distinct, not appressed; surface dull; axial sculpture none; spiral sculpture on the upper whorls two, on the last whorl six strong elevated cords, with somewhat wider channeled interspaces; umbilicus perforate, the anterior cord forming its outer boundary; aperture circular, the outer lip thickened but not reflected, the inner lip thin, sharp; height, 2.25; diameter, 1.75 mm. U. S. Nat. Mus. Cat. No. 271503.

Type-locality.—Todos Santos Bay, Lower California, near San Diego; collected by C. R. Orcutt.

FOSSARUS LUCANUS, new species.

Shell small, whitish, depressed, with a very minute brown nucleus and about two and a half subsequent whorls, the last much the largest; suture distinct, the upper part of the last whorl flattish; spiral sculpture of two very strong keels near the periphery, and two less prominent on the base, with wider minutely spirally threaded interspaces; the top of the whorl is similarly threaded; base moderately rounded with a wide excavation behind the pillar lip leading to a small umbilicus; aperture semicircular, outer lip showing the ends

of the keels, pillar lip straight; height, 1.5; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 59849.

Type-locality.—Cape San Lucas, Lower California; W. H. Dall.

Genus ISELICA Dall, 1918.

Isapis ADAMS, 1853, not of Westwood, 1851.

The generic name being preoccupied, I have proposed the above modification.

ISELICA OBTUSA Carpenter, new variety LAXA.

Shell much resembling *obtusa*, but having a longer and more acute spire, much feebler spiral sculpture, and the whorls more laxly coiled giving the suture a well-marked channel in adults. The color is grayish white, with a yellowish dehiscent periostracum and the umbilicus is a narrow chink, partly covered by the reflected inner lip. Height of shell, 8.5; of last whorl, 6.5; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 219754.

Type-locality.—Maple Bay, Vancouver Island; collected by Mr. Hanham; also not rare in Puget Sound.

? CITHNA ORVIETA, new species.

Shell minute, olive brown, thin, turbinate, of about three rounded whorls, the surface smooth, not polished, the suture distinct; the base convex, imperforate; the aperture subcircular, simple, a chink behind the inner lip, the peristome continuous; height, 0.75; diameter, 0.60 mm. U. S. Nat. Mus. Cat. No. 105466.

Type-locality.—San Diego, California, in sea moss at low water, Henry Hemphill. This species may perhaps be a Rissoid.

CREPIDULA ORBICULATA, new species.

Shell dextral, suborbicular, minutely concentrically wrinkled, white, covered with an olivaceous velvety periostracum; whorls about four counting the (lost) nucleus; the apex curved strongly to the right and elevated (in the type-specimen) about 4 millimeters above the basal margin; back evenly convex; interior subtranslucent white, the edge of the deck prominently produced at the left center with a deep sulcus at the left; there is no cavity under the spire between the deck and the margin; height, 26; length, 20; width, 17 mm. U. S. Nat. Mus. Cat. No. 31100.

Type-locality.—Royal Roads, Victoria, Vancouver Island, in 60 fathoms, on dead bivalve; W. J. Fisher.

This is a rather rare species of quite constant character, usually found in deep water, and ranging from Bering Sea to San Diego, California. The form of the deck approaches that of *Crepipatella*.

CRYPTONATICA SALIMBA, new species.

Shell small, smooth, except for faint incremental lines, yellowish white with a faintly darker band in front of the suture and another

between the periphery and the base; with four evenly rounded whorls slightly flattened in front of a somewhat appressed suture; base rounded, the umbilicus closed by a semilunar convex mass of callus not notched above; the aperture lunate, outer lip thin, the the body callous, the pillar lip somewhat thickened; the operculum is white, porcellanous, of about two whorls; height of shell, 14; of aperture, 10; diameter, 13.5 mm. U. S. Nat. Mus. Cat. No. 209295.

Type-locality.—U. S. Fish Commission station 4423, between Santa Barbara and San Nicolas islands, California, in 216 to 339 fathoms, sand. A very neat and characteristic species, ranging from Esteros Bay to the Gulf of California in deep water.

CRYPTONATICA ALEUTICA, new species.

Natica russa DALL, Proc. Cal. Acad. Sci., vol. 5, p. 251, 1874, not of Gould, Proc. Boston Soc. Nat. Hist., vol. 7, p. 43, June, 1859.

This species was long supposed by me to be Gould's *russa*, but the fortunate recovery of Gould's type indicates that the large Aleutian species requires a name. The rhachidian tooth, like that of *Bulbus*, has a simple cusp, which establishes the subgenus founded on opercular characters.

EUSPIRA ALGIDA Gould.

Natica algida GOULD, Proc. Boston Soc. Nat. Hist., vol. 3, p. 73, Nov. 1848.

The fact that Gould's species was labeled "Rio Negro" has led to the supposition that it is a South American species, but the perfect agreement of Gould's type with an Alaskan and Puget Sound shell has led me to conclude that this locality, like so many other Exploring Expedition localities, is an error. There is, however a Brazilian form, quite similar, which has added to the confusion.

EUSPIRA ACOSMITA, new species.

Shell white with a minutely spirally banded yellow brown periostracum and about four whorls, the nucleus defective; suture distinct, the whorl in front of it a little impressed; axial sculpture of fine silky incremental lines; there is no spiral sculpture; aperture semilunar, oblique, the outer lip thin, the body with a coat of enamel reflected over the umbilical region in a flat pad as in *Cryptonatica*, the pillar lip somewhat thickened; height of shell, 16; of aperture, 13; diameter, 15 mm. U. S. Nat. Mus. Cat. No. 207218.

Type-locality. U. S. Fish Commission station 3128, off Monterey Bay, California, in 627 fathoms, mud; bottom temperature, 38.9° F.

When the operculum is known this may perhaps turn out to be a *Cryptonatica*.

EUSPIRA MONTERONA, new species.

Shell of moderate size, of a dark greenish olive color with a whitish base; whorls about five, the nucleus decorticated; the surface smooth except for faint incremental lines, the suture distinct, not

appressed; base rounded, whitish, the umbilicus narrow, filled below with enamel with a minute perforation above forming a notch-like gap between the white enamel of the inner lip and that of the umbilicus; outer lip thin, sharp; body with a thick coat of enamel, pillar lip much thickened, white; operculum dark brown, of about two whorls; height 19; diameter 18 mm. U. S. Nat. Mus. Cat. No. 220856.

Type-locality.—Station 1199, Captains Bay, Unalaska, in 75 fathoms, mud and gravel; W. H. Dall.

EUSPIRA POLITIANA, new species.

Shell small, white, covered with a pale brown dehiscent periostracum; whorls four and a half, the nucleus decorticated, the specimen probably not quite adult; axial sculpture of retractively radiating grooves from the edge of a channeled suture nearly to one-fifth of the arch of the whorl, with wider interspaces, and faint incremental lines; there is no spiral sculpture; aperture ovate, outer lip thin, sharp, inner lip with a glaze of enamel, thicker under the suture and forming a convex mass over the wholly obliterated umbilicus; pillar lip slightly reflected, the periostracum on the base paler than elsewhere; height of shell, 16; of aperture, 13; diameter, 13 mm. Operculum thin, horny, of two whorls. U. S. Nat. Mus. Cat. No. 205653.

Type-locality.—U. S. Fish Commission station 4779, off Petrel Bank, Bering Sea, in 600 fathoms, sand and pebbles.

If it were not for the umbilicus and operculum, this species might be taken for a *Natica*.

EUSPIRA CANONICA, new species.

Shell small, white under a pale yellowish periostracum, with more than four whorls, the nucleus eroded; suture distinct, narrow, almost channeled; axial sculpture of incremental lines and numerous small irregular wrinkles radiating from the suture and extending on the average about halfway to the periphery; there is no spiral sculpture; base rounded with a small perforate umbilicus partly overshadowed by a narrow reflection of enamel from the pillar lip; aperture semilunate, simple, the body, pillar, and posterior commissure with a liberal coating of enamel; height of shell, 8; of aperture, 5; diameter, 7 mm. U. S. Nat. Mus. Cat. No. 209411.

Type-locality.—U. S. Fish Commission station 2923, off San Diego, California, in 822 fathoms, green mud; bottom temperature, 39° F.

RUMA SUBFUSCA, new species.

Natica fusca CARPENTER, 1864 (name only), not of Blainville, 1825.

Shell depressed conic, fuscous or livid above, whitish below, the wide umbilicus deeply fuscous stained, the aperture deep livid brown-

ish; nucleus minute, glassy, of about two depressed whorls, followed by three strongly appressed subsequent turns; periostracum thin, dehiscent, brownish; sculpture of fine faint incremental, and still fainter obsolete spiral striae; aperture very oblique, body with a heavy white callus, umbilicus wide, funicular, with a brown slightly convex marginal band; height, 31; height of aperture, 27; diameter, 24 mm. U. S. Nat. Mus. Cat. No. 46544.

Type-locality.—Panama, Thomas Bridges.

This species has generally been circulated under the name of *R. otis* Broderip and Sowerby, but that designation has been used to cover a number of probably distinct forms.

SINUM PAZIANUM, new species.

Shell small, grayish white, depressed, with a translucent smooth nucleus of a whorl and a half and two subsequent whorls; suture distinct, outline oval, axial sculpture of faint incremental lines; spiral sculpture of fine incised lines, sometimes close, sometimes with wide interspaces, but barely perceptible except with a lens; last whorl produced, body with a slight glaze of enamel; pillar lip reflected with an umbilical chink behind the reflection, base slightly flattened; longer diameter, 9; shorter diameter, 7; height, 2.5 mm. U. S. Nat. Mus. Cat. No. 211406.

Type-locality.—U. S. Fish Commission station 2823, off La Paz, Lower California, in 26½ fathoms, shelly bottom.

This is next to the smallest of the group on the Pacific coast and ranges from Catalina Island, California, to Panama, usually in deeper water.

SINUM KERATIUM, new species.

Shell small, white, convex, suborbicular, with a minute subglobular nucleus and three subsequent whorls; suture distinct and deep; spiral sculpture of sharp, rather regular grooves with wider interspaces crossed by fine incremental lines, which in places give a punctate effect to the grooves under the lens; the grooves on the base closer and finer; pillar lip slightly reflected over an umbilical chink, body with a thin glaze; long diameter, 6.5; shorter diameter, 5; height, 3.5 mm. U. S. Nat. Mus. Cat. No. 206152.

Type-locality.—Catalina Island, California; collected by W. H. Dall.

This is the smallest Pacific coast species, relatively more convex, and more regularly sculptured than the preceding.

ELACHISINA, new genus.

Shell minute, elevated, with naticoid spiral sculpture, umbilicate.

Type.—Elachisina grippi Dall, new species.

ELACHISINA GRIPPI, new species.

Shell minute, having somewhat the aspect of a short *Cingula*, white, with a very thin periostracum, and four well-rounded whorls, exclusive

of a small glassy subglobular slightly depressed nucleus; the suture constricted but hardly appressed; spiral sculpture of fine uniform striae with slightly wider interspaces, covering the whole shell; aperture subovate, the outer lip thin, the body with a continuous coat of enamel, the pillar arcuate; the umbilicus naticoid, narrow, twisted, with an internal spiral ridge. Operculum? Height of shell, 3; of last whorl 2; diameter, 2 mm. U. S. Nat. Mus. Cat. No. 250230.

Type-locality.—Off San Diego, California, outside the kelp line, in 16 to 20 fathoms, C. W. Gripp.

The true place of the shell is in doubt. It most recalls a minute littoriniform *Eunaticina.*

VELUTINA GRANULATA, new species.

Shell small, white, naticoid, covered with a thin yellowish dehiscent periostracum, with a minute smooth nuclear and three subsequent rounded rapidly expanding whorls; suture distinct, not appressed; sculpture of quite evident but not elevated incremental lines and very minute granulation over the whole surface; aperture ovate, produced, simple; axis imperforate, twisted, the pillar lip hardly thickened, slightly reflected. Height, 5; diameter, 4.5 mm. U. S. Nat. Mus. Cat. No. 214455.

Type-locality.—U. S. Fish Commission station 4441, off Point Pinos, Monterey Bay, California, in 35 fathoms, sand.

This species seems to bridge the gap between species like *V. conica* Dall and the more encoiled Lamellarias as far as the shell is concerned.

TORELLIA AMMONIA, new species.

Shell large, cartilaginous or leathery, depressed, brown, of somewhat more than two whorls; the nucleus, comprising a little more than one whorl, has spiral elevated lamellae with wider interspaces, much as in the larval envelopes of *Lamellaria*, but on a larger scale; the remainder of the shell has close-set axial fringed lamellae; the suture is deep, the aperture entire, wider than high; the umbilicus is pervious, moderately wide, as in *Planorbis trivolvis*, the animal is distinctly Velutinoid, and carries no operculum. Height of dry shell, 12; greatest diameter, 24 mm. U. S. Nat. Mus. Cat. No. 111367.

Type-locality.—Southwest of Sannakh Islands, Alaska, at U. S. Fish Commission station 3213, in 41 fathoms, sandy bottom.

TORELLIA VALLONIA, new species.

Shell small, the earlier part of it with a calcareous lining under a leathery periostracum, the latter part entirely flexible; the general form and aspect that of *Vallonia gracilicosta* on a larger and somewhat less depressed scale; the color is yellowish brown, with about four whorls, the nucleus missing, the rest of the shell with elevated

axial lamellae regularly disposed with much wider interspaces; the aperture entire, with a simple, not thickened, margin; umbilicus open, moderately wide. Diameter about 4 millimeters, the height about 3 millimeters. U. S. Nat. Mus. Cat. No. 219130.

Type-locality.—Dredged in Nazan Bay, Atka Island, Aleutians, in 14 fathoms, sand; W. H. Dall.

This species is not unlike the typical species of the genus from northern Norway, but is more depressed, the whorls less rapidly enlarging and the umbilicus larger. Owing to the character of the nucleus I am led to believe that this genus is nearer to *Velutina* than to *Trichotropis*, the radula on its part showing no marked difference.

COCCULINA CASANICA, new species.

Shell small, brownish or whitish, darker toward the apex, which is at the posterior third of the shell; both slopes slightly convex, the nuclear point always eroded; sculpture near the apex minutely equally reticulate, the sculpture coarser and the radial threads more prominent than the concentric ones toward the margin; interior polished, the muscular impression perceptible but not conspicuous. Length, 5.5; width, 4.5; height, 2.25 mm. U. S. Nat. Mus. Cat. No. 222069.

Type-locality.—U. S. Fish Commission station 4245, in Kasa-an Bay, Alaska, in 95 fathoms, mud; bottom temperature, 48.9° F.

ASTRAEA (PACHYPOMA) INAEQUALIS, new variety PACIFICA.

Shell of moderate size, of a reddish color, trochiform, carinate, of more than five flattish whorls, the apex defective; the carina overhangs a somewhat obscure suture; axial sculpture of numerous (on the last whorl about 70) obliquely protractive, close-set, rounded riblets, which are cut anteriorly into segments by three rather obscure grooves; these riblets bunched in pairs and swollen, undulate the carina, giving it a somewhat stellate profile; on the base from the carina to the umbilical callus are six deep channeled grooves separated by wider interspaces, which are crossed by numerous minute lamellae; the squarish interspaces obliquely nodulous; aperture diamond-shaped, simple, body with a glaze of enamel; pillar concavely arched, white, with a callous deposit on the umbilical area behind it. Height, 25; maximum diameter, 42 mm. U. S. Nat. Mus. Cat. No. 222320.

Type-locality.—Pacific Beach, San Diego, California; Miss J. M. Cooke.

Compared with the typical *inaequale* this form is much more finely and delicately sculptured, and the whorl is notably constricted above the peripheral keel.

ASTRAEA (PACHYPOMA) BARBARENSIS, new species.

Shell of moderate size, trochiform, white, covered by a reddish-brown periostracum, with six or more flattish whorls, the nucleus defective; suture rather obscure, not appressed; axial sculpture of (on the last whorl about 30) rounded, protractively oblique ribs, with equal or wider interspaces, reaching from the suture to the periphery which they undulate; halfway from the suture to the periphery these are cut into segments by three deeply incised grooves; there may be, near the periphery, a few intercalary short ribs; there are also fine, close, inconspicuous incremental lines; on the base inside the undulate border are five strong regularly beaded cords with narrower channeled interspaces; aperture subquadrate, the upper part of the outer lip much produced; the body glazed, the pillar concavely arcuate, ending in a blunt projection, behind it a porcellanous white semilunar callus around the imperforate umbilical depression; height of shell, 26; of aperture, 12; diameter, 37 mm. U. S. Nat. Mus. Cat. No. 223819.

Type-locality.—U. S. Fish Commission station 2945, off Santa Cruz Island of the Santa Barbara group, California, in 30 fathoms, gravel, bottom temperature 56° F.

The operculum, blackish brown inside, of about two whorls, resembles that of *P. inequale*, but is more slender and somewhat concave.

ASTRAEA (PACHYPOMA) SPIRATA Dall.

Pachypoma inaequale var. *spiratum* DALL, Nautilus, vol. 24, p. 111, 1911.

Shell trochiform, elevated, solid, of a reddish color with nacreous substratum, of more than six carinated flattish whorls, the apex, eroded; suture obscure, slightly overhung by the carina which is blunt and undulated; axial sculpture of (on the penultimate whorl about 20) protractively oblique rounded irregular ribs extending from the suture to the edge of the carina with wider interspaces, and cut into nodules by three or four equally spaced spiral grooves; the evident, almost lamellose, retractively oblique incremental lines cross the ribs and interspaces almost at right angles; the flattish base has five sharp channeled grooves with regularly spaced wider squarish interspaces between the imperforate depressed umbilical area and the carina; aperture obliquely rhombic, simple, the body with a thin glaze, the pillar nacreous, concavely arcuate, the outer lip simple produced above; height of shell, 32; of last whorl, 19; of aperture, 11; maximum diameter, 31 mm. U. S. Nat. Mus. Cat. No. 222318.

Type-locality.—Gulf of California; Miss J. M. Cooke.

This is the most elevated and smallest of the subgenus in west American waters. The examination of a number of specimens

indicates that this is a distinct species, and as the original diagnosis was very brief, a full description is now supplied.

LEPTOTHYRA JUANENSIS, new species.

Shell solid, turbinate, very dark olive, with a very minute smooth nucleus and about five well-rounded whorls; suture obscure, not appressed; spiral sculpture of (on the penultimate whorl five, on the last whorl about a dozen) strong, undulate or beaded cords with wider rather deep interspaces; axial sculpture of close, oblique, rather prominent incremental lines; aperture oblique, internally nacreous, the outer lip thin, the body with a glaze of nacre, the pillar lip concave, white, nacreous with two rather formless nodulations anteriorly; height, 8; maximum diameter, 9 mm. U. S. Nat. Mus. Cat. No. 186070.

Type-locality.—Tia Juana, Lower California, near San Diego, California; collected by J. H. Paine.

This is the least attractive and one of the largest species of the genus on the west coast north of Cape San Lucas.

Dr. Paul Bartsch has proposed the varietal name *fenestrata* for a form of *Leptothyra paucicostata*, in which, under the strong spiral sculpture, there is visible in the interspaces a certain number of raised radial threads forming a more or less evident reticulation.

LIOTIA SCITULA, new species.

Shell minute, white with flecks of brown, of about four whorls, including a very minute smooth nucleus; spire flattened, suture distinct; axial sculpture of fine incremental lines, somewhat wrinkled in front of the suture and on the last whorl developing a narrow row of beads at the suture, and crenulating on the base the margin of the umbilicus; spiral sculpture of a very prominent, minutely crenulated keel at the periphery and a smaller one on which the suture is laid; the margin of the narrow umbilicus is also thread-like; aperture rounded except where modified by the external sculpture; the body with a glaze of enamel, the pillar lip somewhat thickened; height of shell, 1; maximum diameter, 2 mm. U. S. Nat. Mus. Cat. No. 194975.

Type-locality.—U. S. Fish Commission station 2813, among the Galapagos Islands, in 40 fathoms, coral sand.

The specimen may not be entirely adult and the aperture in the full-grown shell may be modified from the above description.

MÖLLERIA DRUSIANA, new species.

Shell minute, of two and a half rapidly enlarging whorls, whitish, covered with an olivaceous periostracum; suture distinct, rather deep; whorl section circular, surface smooth except for microscopic

incremental lines; base convex with a rather wide umbilicus; aperture circular, simple, sharp edged; operculum calcareous, multispiral, centrally depressed on the outer side; height, 1; larger diameter, 1.5 mm. U. S. Nat. Mus. Cat. No. 31117.

Type-locality.—Constantine Harbor, Amchitka Island, Aleutians, in seaweed at low water, W. H. Dall.

CHLOROSTOMA GALLINA, new variety UMBILICATUM.

Most of the specimens of *Chlorostoma gallina* are imperforate, some have the umbilical callus concave, forming a sort of pit, and a rare variety has an entirely open, narrow, deep umbilicus. The types of the latter are U. S. Nat. Mus. Cat. No. 152998, and while in other characters similar, are smaller than the average adult *gallina*, measuring, height 22 and diameter 25 mm. They were collected by Turrill at San Quentin Bay, Lower California. Other specimens have been found at San Diego, California.

CHLOROSTOMA BRUNNEUM, new variety FLUCTUOSUM.

The common form of *brunneum* has a nearly smooth surface or a surface affected by incremental rugosities, but there is another form rather widely spread which exhibits well-marked obliquely protractive ribs to the number of 18 or 20 on the last whorl, reaching from the suture nearly to the periphery with narrower interspaces. It is rather less elevated than the average of the typical *brunneum* and has a more depressed suture. The types of the variety are U. S. Nat. Mus. Cat. No. 60055 and come from Monterey, California.

OMPHALIUS MARIANUS, new name.

This is *O. coronatus* Pilsbry, 1889, not of C. B. Adams, 1852, and *O. turbinatus* Pease, 1869, not of A. Adams, 1851. A new name for the species being needed, the above is proposed. The *O. marianus* ranges from Santa Barbara, California, to Panama and Paita, Peru, and is U. S. Nat. Mus. Cat. No. 4033.

CALLIOSTOMA COSTATUM, new variety CAERULEUM.

Shell resembling the ordinary typical form except that the apex and part of the whorls in front of the suture are colored with bands of a brilliant mazarin blue when fresh, but which, unfortunately, fades after a few years in the cabinet. Fresh specimens have a very different aspect from the common shells carrying reddish spiral lines on a yellowish ground. Typical specimens in the National Collection come from Monterey, California, and bear the catalogue number 59808.

CALLIOSTOMA COSTATUM, new variety PICTUM.

These shells resemble the type except that on the periphery of the whorl, and sometimes on the whorl between the periphery and the

preceding suture, the shell is adorned with alternating light and dark patches or clouds of color. Typical specimens come from Neeah Bay, Washington, and bear the number 12612*a*.

CALLIOSTOMA CANALICULATUM, new variety NEBULOSUM.

Shell resembling the typical form except that the whorls are painted with small brown nebulous patches in a radial fashion; specimens of this kind from San Diego, California, illustrate the variety and are numbered 159251.

CALLIOSTOMA CANALICULATUM, new variety TRANSLIRATUM.

Another variation occurs in the northern part of the range of this species, from Sitka to the Straits of Fuca, in which the channels between the yellowish spiral cords are of a dark reddish brown, giving the shell a somber appearance, much in contrast with the light straw-colored type from southern California. Specimens of the former kind are in the collection from Biorka Island, Sitka Sound, and are numbered 160558.

A dark and comparatively small form of *C. gloriosum* Dall seems to be characteristic of specimens from the southern extreme of the range of this species, especially in the vicinity of San Diego.

SOLARIELLA RHYSSA, new species.

Shell small, trochiform, translucent, with four whorls, including a smooth nucleus of a whorl and a half; suture distinct; whorl-section circular; axial sculpture of (on the last whorl 35) narrow threadlike ribs, regularly spaced, uniform, the interspaces wider; extending from the suture to the verge of the umbilicus; spiral sculpture of minute spiral threads showing in the interspaces under a lens, but not modifying the axial ribs; umbilicus wide, funicular; aperture circular, simple, sharp edged; operculum brown, multispiral, horny; height, 1.7; longer diameter, 2 mm. U. S. Nat. Mus. Cat. No. 173803.

Type-locality.—Catalina Channel, California; collected by Prof. F. W. Kelsey. This shell is probably not quite adult.

SOLARIELLA TAVERNIA, new species.

Shell small, white, with a subglobular nucleus and three and a half subsequent whorls; suture distinct, deep; spiral sculpture on the spire of four or five equally distributed and subequal small threads with wider interspaces and a narrow flattish space in front of the suture; intercalary threads appear on the penultimate whorl and on the first half of the last whorl they become numerous, covering the whole surface uniformly, but a little coarser on the verge of the umbilicus which is moderately wide and deep; this sculpture becomes

obsolete and the last quarter of the last whorl is perfectly smooth and polished; axial sculpture of numerous retractively arcuate threads beginning at the suture and extending feebly to the periphery on the upper part of the spire, later becoming obsolete; base rounded, aperature subcircular, simple, sharp, the lips connected by a glaze on the body and not reflected; height, 3; greater diameter, 4 mm. U. S. Nat. Mus. Cat. No. 207625.

Type-locality.—Galapagos Islands, in 634 fathoms, sand; bottom temperature, 40° F.

SOLARIELLA (SOLARICIDA) HONDOENSIS, new species.

Shell of moderate size with six moderately inflated whorls, the nucleus lost, the color olivaceous, the suture distinct, not appressed; spiral sculpture of (on the upper whorls two, on the last two whorls three) sharp threads behind the periphery raised into rather sharp nodules at the intersections with the axial threads, and with wide interspaces between the suture, each other and the following threads, the first of which on which the suture is laid and three similar threads on the base are minutely beaded, while the last, at the verge of the funnel shaped axially striated deep umbilicus is more coarsely beaded; axial sculpture of fine sharp threads more or less obsolete in the interspaces but forming nodules at the intersections and between them finer sharp close threadlets; not nodulating the posterior spirals; base convex, aperture rounded, the pillar and outer lip continuous thin and sharp, the inner lip erased, pearly; operculum thin, multispiral; height of shell, 19; maximum diameter, 17 mm. U. S. Nat. Mus. Cat. No. 205778.

Type-locality.—U. S. Bureau of Fisheries station 4974, off Hondo, Japan; in 905 fathoms, mud; bottom temperature 36.6° F.

SOLARIELLA DIOMEDEA, new species.

Shell small, white with pinkish brown touches on the prominences and four or five brown radial flecks on the spire; whorls five exclusive of the glassy subglobular nucleus, flattened in front of the suture, otherwise well rounded; spiral sculpture on and near the periphery of five or six subequal cords with narrower interspaces; on the base are about eight finer closer threads extending to the verge of the funicular umbilicus within which are four stoutly beaded strong cords diminishing in strength inward; axial sculpture of numerous fine equal regularly spaced threads with wider interspaces, beading the posterior spiral and conspicuous on the flattish part of the whorl; aperture circular, hardly interrupted at the body, the margin thin, crenulated by the sculpture; operculum multispiral, concave, translucent; height of shell, 4; diameter, 5 mm. U. S. Nat. Mus. Cat. No. 194971.

Type-locality.—U. S. Fish Commission station 2813, at the Galapagos Islands, in 41 fathoms, coral sand.

This though much smaller, belongs to the type of *S. peramabilis* Carpenter.

SOLARIELLA NYSSONA, new species.

Shell small, white, prickly, with six well rounded whorls exclusive of the one-whorled glassy very minute nucleus; suture deep, almost channeled; spiral sculpture of a prominent line of sharp nodules at the shoulder of the whorl in front of which, between it and the base, are three widely spaced threads similarly but less prominently nodulate at intersections with the axial sculpture and with one or two fine intercalary threads in the much wider interspaces; on the base are four or more equal small beaded threads with wider interspaces to the verge of the funicular umbilicus which is marked by one or two rows of prominent sharp nodules; internally the umbilicus is axially striated; axial sculpture of numerous sharp, widely spaced, often broken, elevated lines sharply nodulose at the intersections; aperture subcircular, the margin thin, sharp, hardly interrupted by the body. Height, 6; diameter, 7.5 mm. U. S. Nat Mus. Cat. No. 205799.

Type-locality.—U. S. Bureau of Fisheries station 3738, off Hondo, Japan, in 167 fathoms, mud; bottom temperature, 67° F.

SOLARIELLA DELICATA, new species.

Shell small, white, with about four well rounded whorls exclusive of the rather prominent minute glassy nucleus; suture distinct, almost appressed; spiral sculpture of a prominent thread at the shoulder, two with an intercalary smaller thread at the verge of the umbilicus and numerous feeble minute elevated lines under-running the axial sculpture; umbilicus narrow, deep; axial sculpture of very numerous, equal, regularly spaced low lamellae, with (on the last whorl) about equal interspaces, extending to the verge of the umbilicus and minutely beading the shoulder cord; aperture circular, hardly interrupted by the body, the margins thin and sharp; height, 7; diameter 6.5 mm. U. S. Nat. Mus. Cat. No. 205780.

Type-locality.—U. S. Bureau of Fisheries station 5050, near Hakodate, Japan, in 266 fathoms, sand; bottom temperature, 37.9° F.

This is one of the most elegant species of this very beautiful genus.

SOLARIELLA KOREANICA, new species.

Shell small, white, with four well rounded whorls exclusive of the minute glassy nucleus, and a distinct not appressed suture; spiral sculpture of a feeble thread at the base and two stronger, rather widely separated, sharper threads around the narrow umbilicus; spiral sculpture of (on the last whorl about 25) obliquely retractive

low folds which barely reach the periphery, with narrower interspaces, but are feebly and irregularly revived on the base, especially near the umbilicus; aperture subcircular, hardly interrupted by the body, with a sharp thin margin; height, 5; diameter, 4.5 mm. U. S. Nat. Mus. Cat. No. 205783.

Type-locality.—U. S. Bureau of Fisheries station 4852, off the coast of Korea (Chosen) in 568 fathoms, mud; bottom temperature, 36.6° F.

MARGARITES PAUPERCULUS, new species.

Shell coarse, usually more or less eroded, of a yellowish white over a brilliant nacre, with five or more moderately rounded whorls, the nucleus eroded; suture distinct, not appressed; axial sculpture of numerous somewhat irregular narrow close-set wrinkles, extending over the whorl from the suture to the verge of the funicular umbilicus; spiral sculpture of a few spiral lines near the umbilicus; aperture subcircular, oblique, produced above, the lips joined over the body by a layer of enamel; the operculum dark brown, multispiral, with 8 or 10 turns; height of shell, 9.5; of aperture, 4.5; maximum diameter, 11 mm. U. S. Nat. Mus. Cat. No. 109457.

Type-locality.—Arctic Ocean, north of Bering Strait; collected by Capt. E. Everett Smith.

MARGARITES (PUPILLARIA) KAMCHATICUS, new species.

Shell large, solid, ashy gray, somewhat depressed, with six whorls exclusive of the (lost) nucleus; suture distinct, not appressed; axia sculpture of radiating threads near the apex, soon becoming obsolete and reduced on the last three whorls to somewhat rude incremental lines, slightly sharper and more regular on the base; spiral sculpture of two close and one larger peripheral cord between the sutures on the spire, on the last whorl these occupy the posterior half of the space between the suture and the periphery; in front of them is a space without spiral sculpture reaching to the periphery; on the base between the periphery and the verge of the umbilicus there are about a dozen spiral uniform threads with wider interspaces decussated only by the lines of growth; the interior of the rather wide umbilicus is axially striated; the periphery is rounded; aperture oblique, subquadrate, the margins thin, the body with a thin layer of nacre; the pillar is slightly concavely arcuate. Height of shell, 23; of last whorl, 18; diameter, 27 mm. U. S. Nat. Mus. Cat. No. 210275.

Type-locality.—U. S. Bureau of Fisheries station 3643, on the southeast coast of Kamchatka, in 100 fathoms sand; bottom temperature, 31.7° F.

MARGARITES (PUPILLARIA) HEALYI, new species.

Shell large, livid yellowish white, with a thin very pale periostracum and about six whorls including a smooth white turbinate nucleus

of two moderately rounded whorls; suture distinct, not appressed, the whorls between not inflated; axial sculpture of oblique quite evident incremental lines, occasionally developed into minute wrinkles; spiral sculpture of rather irregularly spaced low threads, about a dozen on the penultimate whorl, with wider interspaces; especially near the periphery on the spire; on the last whorl, including the base, they are more numerous and closer; base slightly flattened with a narrow, perforate umbilicus; aperture oblique; simple, nacreous; body with a coat of enamel; pillar straight, slightly callous, with no projection at the base; height of shell, 20.5; of last whorl, 15; maximum diameter, 20 mm. U. S. Nat. Mus. Cat. No. 223801.

Type-locality.—Arctic Ocean, north of Bering Strait, station 10, of U. S. S. *Corwin*, Capt. M. Healy.

MARGARITES (PUPILLARIA) SHANNONICUS, new species.

Shell large, thin, gray, with a dull surface, trochiform, with a minutely glassy globular nucleus and five subsequent whorls, suture distinct, deep; axial sculpture of prominent, almost lamellose close-set incremental lines, which near the apex of the shell develop as stronger wrinkles; spiral sculpture of (on the penultimate whorl four, on the last whorl between the suture and the base five or more) low keels, with much wider interspaces and occasional intercalary threads; just over the edge of the base and around the deep rather narrow umbilicus are other fine threads with a more or less smooth space between the two groups; aperture rounded, outer lip somewhat produced above, pearly, with a thin layer of enamel across the body; pillar lip thin, hardly reflected; larger diameter, 14; shorter diameter, 11.5; height, 13 mm. Operculum whitish, of about 10 turns, fringed externally at the suture. U. S. Nat. Mus. Cat. No. 219265

Type-locality.—Shannon Fiord, East Greenland, Doctor Pansch.

This recalls *M. striatus* Broderip and Sowerby, but is a thinner and more delicate shell with quite different minor characters. The ovicapsules attached by the base to the specimens are discoid and appear to hold only one or two eggs.

MARGARITES (PUPILLARIA) RUDIS, new species.

Shell of moderate size, white, with a pale olivaceous periostracum, a smooth nucleus of about one whorl and five subsequent whorls; spiral sculpture of two strong cords with wider interspaces and a third on which the suture is laid and which forms the margin of the base; there is also a small thread between the suture and the posterior cord and on the last whorl a similar thread in the interspaces; on the base there are six or seven smaller closer cords separated by obscurely channeled interspaces between the verge of a narrow umbilicus and the basal margin; axial sculpture of (on the penultimate whorl about 20) retractive riblets extending from suture to periphery, with wider

interspaces, slightly nodulous at the intersections with the spiral cords; there are also close obvious incremental regular lines over the whole surface; aperture rounded quadrate, simple, a glaze on the body, the pillar lip slightly thickened; operculum multispiral. Height, 12; diameter, 12.5 mm. U. S. Nat. Mus. Cat. No. 213951.

Type-locality.—Coal Harbor, Shumagins, Alaska, in 8 fathoms, mud; collected by W. H. Dall. Also Arctic and Kamchatka coasts.

MARGARITES (PUPILLARIA) ROSSICA, new species.

Shell large, solid, trochiform, of a pale gray color over a brilliant nacre; whorls eight, including a small pinkish nucleus of two whorls; spiral sculpture of (on the spire three) strong blunt keels, of which two near the periphery are the most prominent, with subequal wide interspaces; there is a fourth less prominent one on which the suture is laid which only shows on the last whorl; on the base there are about 10 smaller cords irregularly spaced; axis perforate by a narrow twisted umbilicus; axial sculpture of very fine close uniform sharp incremental lines; aperture rounded-quadrate, simple; outer lip thin, sharp, undulated by the sculpture; body lightly glazed; pillar lip slightly tortuous, hardly thickened, with a slight angle at the anterior end; height of shell, 32; of last whorl, 22; maximum diameter, 30 mm. U. S. Nat. Mus. Cat. No. 111046.

Type-locality.—U. S. Bureau of Fisheries station 5012, in Aniwa Bay, Sakhalin Island, in 40 fathoms, mud.

This appears to be the largest and finest species of the group.

MARGARITES (LIRULARIA) INFLATULA, new name.

Margarites inflata CARPENTER, Rep. Brit. Assoc. for 1863, p. 139, 1864, not of Brown (as *Trochus*) Mem. Wernerian Society, vol. 8, pl. 1, fig. 10, 1839.—MORRIS, Cat. Brit. Foss., ed. 2, p. 257, 1854; nor of Totten, 1834.

This species is incorrectly placed in the synonymy of *M. pupilla* Gould in Tryon's Manual. The type is from Puget Sound, collected by Dr. C. B. Kennerly. U. S. Nat. Mus. Cat. No. 4494.

MARGARITES (LIRULARIA) ALTHORPENSIS, new species.

Shell small, solid, trochiform, nacreous white, with a minute subglobular smooth nucleus and five subsequent whorls; spiral sculpture of five uniform prominent threads on the upper half of the last whorl and between the sutures on the spire, with wider interspaces; on the base the threads are more numerous, smaller and with subequal interspaces, extending from near the periphery to the umbilicus, which is perforate and not internally sculptured; axial sculpture of fine regular incremental lines not modifying the spirals; aperture rounded-quadrate, simple, sharpedged, the lips connected by a glaze on the body, not anywhere reflected; height, 3; larger diameter, 3.2 mm. U. S. Nat. Mus. Cat. No. 208559.

Type-locality.—Granite Cove, Port Althorp, Alaska, in 14 fathoms, gravel; W. H. Dall.

MARGARITES HELICINUS, new variety ELEVATUS.

Shell small, trochiform, polished, purple-brown, with a dark glassy nucleus and about five subsequent well-rounded whorls; suture distinct, rather deep; sculpture of evident incremental lines without any spiral striae; base rounded with a small umbilical chink; aperture simple, rounded, slightly angular at the suture, the body with a well-marked glaze uniting the outer lips with a rather wide, white, slightly reflected pillar lip; operculum brownish with about 10 turns; arger diameter, 9; shorter diameter, 7; height, 6.5 mm. U. S. Nat. Mus. Cat. No. 205833.

Type-locality.—Bear Bay, Baranoff Island, Alaska, collected by Mrs. Kate Stephens. This is closely related to the typical *M. helicinus*, but its form is more trochoid; it has a larger number of whorls and its aperture more nearly circular.

MARGARITES HELICINUS, new variety EXCAVATUS.

Shell small, depressed, thin, polished, lurid flesh color with a darker globular glassy nucleus, and about three subsequent whorls, on which a few spiral lines of obscurely lighter color are sometimes apparent; suture distinct, not appressed; surface with faint incremental lines as the only sculpture; base rounded with, in the adult, a widely excavated funicular umbilicus, aperture rounded, simple, more or less patulous when mature; inner lip with a moderate coat of enamel continued on to the pillar lip and slightly reflected there; larger diameter, 9; shorter diameter, 5.5; height, 3.5 mm. U. S. Nat. Mus. Cat. No. 219144.

Type-locality.—Constantine Harbor, Amchitka, Aleutian Islands, collected by W. H. Dall. Also at Middleton Island, Alaska.

MARGARITES PRIBILOFFENSIS, new species.

Shell small, solid, trochiform, pale straw color, with a small glassy nucleus and about five and a half subsequent well rounded whorls; suture distinct, slightly appressed; surface dull, with fine incremental lines crossed by extremely fine spiral striae; base well rounded with a deep, not funicular umbilicus, aperture rounded, simple, the outer lip produced at the suture and united with the pillar by a thin glaze of enamel over the body, the pillar lip a little thickened, not reflected; operculum brownish with eight or more turns; larger diameter, 8.5; shorter diameter, 7; height, 8 mm. U. S. Nat. Mus. Cat. No. 210130.

Type-locality.—U. S. Fish Commission station 3504, near the Pribilof Islands, Bering Sea, in 34 fathoms, sand; bottom temperature, 37.8° F.

This species resembles *M. marginatus* but is larger, more solid, not fluctuated, nor angular at the periphery, and with a different suture.

MARGARITES FRIGIDUS, new species.

Shell small, polished, conic, pale flesh color, of six whorls, including a minute subglobular nucleus; suture distinct, not appressed, whorls only moderately rounded; axial sculpture of faint incremental lines, spiral sculpture of a few very faint lines near the umbilical region; base rounded, imperforate; operculum pale brown with about 8 turns; aperture rounded, slightly angular above, outer lip simple sharp, body with a thin nacreous glaze, pillar lip rounded, broader than the rest; height of shell, 9; of last whorl, 6.5; of aperture, 3; diameter, 6 mm. U. S. Nat. Mus. Cat. No. 223423.

Type-locality.—Arctic Ocean north of Bering Strait; Capt. M. Healy of the U. S. R. M. steamer *Corwin*. This species occurs also as far south as Nunivak Island.

MARGARITES MARGINATUS, new species.

Shell small, thin, trochiform, pale gray or pink, with a minute glassy nucleus and about five subsequent whorls; suture distinct, rather deep, in front of it the last whorl is marginated by a series of eight or more slightly arcuate broad convex waves with narrow interspaces, extending about halfway to the periphery which is somewhat angular though not distinctly keeled; other spiral sculpture of minute almost microscopic striae over the whole surface; base moderately convex with a narrow umbilicus; aperture rounded, simple, the margin not expanded, the body with a thin layer of enamel uniting the lips, the pillar lip not reflected, slightly thickened; the operculum pale with six or more turns; larger diameter, 6.5; shorter diameter, 5; height, 5 mm. U. S. Nat. Mus. Cat. No. 109464.

Type-locality. –Adakh Island, Aleutians, collected by W. H. Dall. It has also a wide range including the Arctic Ocean in both hemispheres. The wavy margin, though always indicated, is variable in strength in different individuals.

MARGARITES HYPOLISPUS, new species.

Shell small, solid, turbinate, pale flesh color, polished, smooth, with five well rounded whorls, including a minute subglobular nucleus; suture very distinct, not appressed; base rounded with a narrow deep perforate umbilicus; aperture subcircular, simple, the pillar lip hardly thickened, the body with a thin coat of enamel; height, 3.5; diameter, 4.5 mm. U. S. Nat. Mus. Cat. No. 274122.

Type-locality.—Arctic Ocean north of Bering Strait; Capt. M. Healy. This species was at first taken for the young of *M. frigidus*, but that is imperforate, more elevated, and with fewer whorls, and has less rotundity of the whorls.

? CIRCULUS ROSSELLINUS, new species.

Shell minute, white, solid, depressed turbinate, of two-and-a-half whorls, including the smooth nucleus; suture distinct; sculpture of numerous close-set spiral threads rather large for the size of the shell, crossed by microscopic incremental lines; base rounded, with a narrow deep umbilicus; aperture subcircular, the outer lip sharp, much produced above, pillar lip thickened, not reflected; height, 0.75; longer diameter, 2 mm. U. S. Nat. Mus. Cat. No. 223286.

Type-locality.—Off South Coronado Island, near San Diego, California, collected by Dr. Fred Baker, in three fathoms.

GANESA (GRANIGYRA) PIONA, new species.

Shell minute, white, of about three well-rounded whorls of which the smooth small nucleus forms one; suture deep; surface covered with a minute subgranular vermiculation, the incremental lines hardly perceptible; base evenly rounded, the umbilicus narrow; the aperture subcircular, the margin slightly thickened, not interrupted by the body; height, 2; diameter, 2 mm. U. S. Nat. Mus. Cat. No. 207624.

Type-locality.—U. S. Fish Commission station 2808, near the Galapagos Islands, in 634 fathoms, coral sand; bottom temperature, 39.9° F.

GANESA (GRANIGYRA) FILOSA, new species.

This species is much like the preceding one but with coarser sculpture in which the elevations take the form of somewhat irregular slightly retractive very narrow folds, stronger near the suture and on the base, less conspicuous on the periphery, and with a subsculpture of revolving striae which at times roughen the threadlike folds; the shell has one more whorl than *G. piona* but in all respects except those above noted is extremely similar; the operculum is horny, subtranslucent and multispiral; height, 2.3; diameter, 2.5 mm. U. S. Nat. Mus. Cat. No. 207602.

Type-locality.—This is the same as that of *G. piona*.

In her useful paper on *Cyclostrema*, *Adcorbis*, etc., in the Transactions of the Connecticut Academy of Sciences[1] Miss Bush proposes a new genus *Lissospira* with subordination of older names as subgenera or sections. The correct arrangement, however, would have been to accept *Ganesa* Jeffreys, 1883, as the genus, with *Granigyra* Dall, 1889, as subgenus and *Lissospira* Bush, 1897, as a section of the latter, with smooth or nongranular shell. From a smooth shell to one with granules and by coalescence of granules into vermiculation, and this into plications, is a series of steps not too difficult or important.

[1] Vol. 10, 1897, pp. 98–144.

TEINOSTOMA (PSEUDOROTELLA) SAPIELLA, new species.

Shell minute, white, translucent, solid, of about two whorls, including a minute dark brown subglobular nucleus; suture distinct; surface glossy, smooth; last whorl only moderately enlarged and little produced at the aperture; base rounded, depressed in the center,with a pad of enamel leaving a slight chink but no perforation in the umbilical region; aperture subcircular, the outer lip thin, a thick callus on the body and a large ovate pad behind the pillar lip; height, 1; longer diameter, 2 mm. U. S. Nat. Mus. Cat. No. 127560.

Type-locality.—San Pedro, California, Mrs. Oldroyd.

TEINOSTOMA (PSEUDOROTELLA) BIBBIANA, new species.

Shell minute, very similar to the preceding, but smaller, more depressed relatively, and more transparent and thin; aperture circular, with a thinner callus on the body, and only a small linguiform pad behind the pillar lip. Height, 0.75; longer diameter, 2 mm. U. S. Nat. Cat. No. 274123.

Type-locality—San Diego, California, Mrs. Oldroyd.

TEINOSTOMA (PSEUDOROTELLA) SALVANIA, new species.

Shell small, translucent white, moderately depressed, smooth, of about three and a half whorls with a minute inflated nucleus; the only sculpture is a few faint incremental lines; base rounded, convex, imperforate, with a minute umbilical dimple, behind which is a small callus; aperture ovate, simple, the outer lip arcuate, simple, hardly produced except near the suture, with a retractive wave near the periphery; pillar thick with a small callus behind it; height, 1.2; larger diameter, 1.8 mm. U. S. Nat. Mus. Cat. No. 225190.

Type-locality—Off South Coronado Island, near San Diego, California, in 3 fathoms, Dr. Fred Baker.

TEINOSTOMA (PSEUDOROTELLA) CECINELLA, new species.

Shell small, translucent white, glassy, smooth, of two and a half depressed whorls, the suture smoothly appressed and the apex not rising above the summit of the last whorl; last whorl produced at its extremity, the umbilical region covered with a smooth pad of enamel, the aperture subcircular with thick simple lips and a slight angularity at what would be the end of the pillar if there were a pillar; height, 2; longer diameter, 3.5 mm. U. S. Nat. Mus. Cat. No. 218341.

Type-locality—Magdalena Bay, Lower California; collected by C. R. Orcutt.

SCISSURELLA CHIRICOVA, new species.

Shell small, white, trochiform, with a minute subglobular nucleus and about four and a half subsequent whorls; spiral sculpture of two sharp narrow peripheral keels, with a narrow interspace inclosing the anal sulcus and fasciole; on the outer side of each keel is a moderate constriction of the whorl; the suture is laid just below the anterior keel; there are also very minute spiral threads over the whole surface which do not reticulate the axial sculpture; the latter is composed of retractively arcuate, uniform, minute, close-set threads extending over the flattish upper surface of the whorls and the roundly convex base; axis perforate, the umbilicus small, the aperture rounded except the rather straight, somewhat reflected, short pillar lip; operculum multispiral, whitish, subtransparent; height, 2.5; diameter, 3 mm. U. S. Nat. Mus. Cat. No. 206509.

Type-locality—U. S. Fish Commission station 3340, southeast of Chirikoff Island, Alaska, in 695 fathoms, mud; bottom temperature, 36.8° F.

SCHISMOPE CALIANA, new species.

Shell minute, translucent white, of three whorls and a minute glassy subglobular nucleus; suture distinct; last whorl with a keel halfway to the periphery, another at the periphery; half a whorl back from the aperture between these two is the oval perforation found in the genus; these interspaces are wide; a third keel is found nearer the second on the outer part of the base, and several finer ones on the base, which is funnel-shaped in the center, but forms merely a pit, the axis being imperforate; aperture wide the upper part of the outer lip protracted; the pillar lip thin, arcuate, the general form of the aperture rounded; height, 1 mm., maximum diameter, 1.5 mm. U. S. Nat. Mus. Cat. No. 198609.

Type-locality—San Diego, California, Professor Kelsey.

HALIOTIS CRACHERODII, new form IMPERFORATA.

In the Nautilus for December, 1910 (p. 96), I described a unique form of this species which is entirely imperforate, never having had any perforations, but appears normal in every other respect. While this can hardly be termed a variety it seems well to give it a name in order that it may be kept in mind by those interested in teratology of mollusca. The specimen is U. S. Nat. Mus. Cat. No. 219850, and measures 100 mm. in length by 42 in height and 95 in width, and was collected on the coast of California not far from San Pedro.

SPHENIA GLOBULA, new species.

Shell small, white, with a dehiscent brownish papery periostracum which extends beyond the shell at the siphonal end; almost

spherically inflated, short, truncate behind; beaks inconspicuous, situated about the middle of the valves; anteriorly the valves are rounded, behind they are compressed into a short rostrum about one-fourth the whole length; sculpture of rather rude lines of growth, the external layer obscurely granulose, especially in front; interior of the valves chalky white, the muscular impressions distinct, the pallial sinus rounded, slightly less than half the length of the valve its impression formed by two almost separate rather broad patches; hinge as usual in the genus. Length, 12; height, 9; diameter, 9 mm. U. S. Nat. Mus. Cat. No. 218977.

Type-locality—Baulinas Bay, California, Mrs. T. S. Oldroyd.

This is by far the most inflated and subspherical member of the genus from the west coast.

NOTES ON CERTAIN GENERA OF ICHNEUMON-FLIES WITH DESCRIPTIONS OF A NEW GENUS AND FOUR NEW SPECIES.

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The subtribe Thymaridina of the tribe Mesoleptini was originally formed under the name Thymarides by Thomson [1] for the genera *Oedemopsis* Tschek, *Thymaris* Foerster, and *Neliopisthus* Thomson. The first of these has since been shown to be synonymous with *Hybophanes* (Foerster) Schmiedeknecht, the genotypes being synonymous. To these three is now to be added the new genus described below.

The systematic position of *Hybophanes* (Foerster) Schmiedeknecht has been a subject of much disagreement among systematic workers it and its various synonyms having been placed in no less than five tribes, representing three of the Ashmeadian subfamilies. It was originally placed by Foerster [2] in his family Lissonotoidae.

Tschek,[3] redescribing it under the name *Oedemopsis*, placed it in the Pimplinae. Brischke [4] synonymized *Oedemopsis rogenhoferi* Tschek, the genotype of *Oedemopsis*, with *Tryphon scabriculus* Gravenhorst and placed it in the Tryphoninae, considering it allied to *Eclytus* Holmgren, as did also Snellen van Vollenhoven.[5]

Thomson,[1] referred *Oedemopsis* along with *Thymaris* Foerster and *Neliopisthus* Thomson to his subtribe Thymarides, tribe Mesoleptina. Davis,[6] considering the Plectiscini as a tribe of the Tryphoninae, placed the synonymous *Campothreptus* Davis (not Foerster), based on the North American (*Tryphon*) *Hybophanes nasutus* (Cresson), in that tribe. Ashmead [7] left *Hybophanes* where Foerster placed it, but redescribed it [7] (p. 59) in the Pimplini as *Zarynchus* with *Tryphon? nasutus* Cresson as type. *Zarhynchus* being preoccupied he later [8] proposed the substitute *Rhynchothyreus*. Morley,[9]

[1] Opusc. Ent., fasc. 9, 1883, pp. 906–908.
[2] Verh. Nat. Ver. Prov. Preuss. Rheinl., vol. 25, 1868, p. 166.
[3] Verh. Zool.-Bot. Ges. Wien, vol. 1, 1868, p. 276.
[4] Deutsche Ent. Zeitschr., vol. 21, 1877, p. 285–286.
[5] Pinacographia, 1880, pl. 32, fig. 1.
[6] Trans. Amer. Ent. Soc., vol. 24, 1897, p. 247.
[7] Proc. U. S. Nat. Mus., vol. 23, 1900, p. 49.
[8] Can. Ent., vol. 32, p. 368.
[9] Brit. Ichn., vol. 3, 1908, pp. 258, 268.

admitting that it is perhaps more closely related to the Tryphoninae than to the Pimplinae, still retains it in the Pimplinae, and, under the name *Oedematopsis*, assigns it and *Thymaris* to the tribe Acoenitides and adds a new species. Schmiedeknecht [1] retained it in the Pimplinae, where he tabulated it between *Lampronota* and *Arenetra*, although he took note of Thomson's placing of it. Later [2] he tabulated it with *Neliopisthus* and *Thymaris* in the Tryphoninae; and still later [3] he follows Thomson, using the name *Hyophanes*, and calling the tribe and subtribe Mesoleptini and Thymaridina, respectively. Viereck [4] places *Hybophanes nasutus* (Cresson) in his genus *Plectiscidea* under the name *Plectiscidea* (*Campothreptus*) *nasuta* Cresson.

Thymaris has been the basis of but little less disagreement than has *Hybophanes*. Originally placed by Foerster [5] in his family Campoplegides, where the only characters assigned to it are those employed in the key, no species was assigned to it until Brischke [6] described his *Thymaris pulchricornis*. Brischke also considered the genus Campoplegine. Thomson [7] described two species and removed the genus, under the name *Thymarus*, to his subtribe Thymarides. Bridgeman and Fitch [8] and later Bridgeman [9] described *Thymaris fasciatus*, which, as pointed out by Schmiedeknecht [3] almost certainly does not belong to the genus as typified by *pulchricornis* Brischke, but is apparently a true Campoplegine. Ashmead [10] followed Foerster in his placing of *Thymaris*. Pfankuch [11] synonymized *Thymaris pulchricornis* Brischke with *Mesoleptus tener* Gravenhorst. Schmiedeknecht,[2] without referring it to any tribe, tabulated it in a generic synopsis of the Tryphoninae; and later [3] adopted Thomson's disposition of the genus. He synonymized *compressus* Thomson with *pulchricornis* Brischke and expressed doubt of the synonymy of Brischke's species with *Mesoleptus tener* Gravenhorst, though admitting that a part of the male material of Gravenhorst's species belongs here. Morley [12] placed *Thymaris* with *Oedemopsis* in the Acoenitini and described a new species.

Neliopisthus Thomson, aside from its original description by Thomson,[7] has been treated at length only by Schmiedeknecht,[3] who follows Thomson in his disposition of the genus. Ashmead,[13] failing to recognize it, redescribed it as *Polysphinctomorpha* and placed it in the Pimplini. In the same work (p. 179) he simply listed *Neliopisthus* in his bibliography of the genera.

[1] Zool. Jahrb., vol. 3, 1888, p. 435.
[2] Hym. Mitteleu., 1907, p. 620.
[3] Opusc. Ichn., fasc. 32, 1912, pp. 2504–2507.
[4] Hym. Conn., 1917, p. 276.
[5] Verh. Nat. Ver. Prov. Preuss., vol. 1, 1868, p. 151.
[6] Schrift. Naturf. Ges. Danzig, new ser., vol. 4, 1880, pt. 4, p. 145.
[7] Opusc. Ent., fasc. 9, 1883, pp. 906–909.
[8] Entomologist, vol. 18, 1885, p. 100.
[9] Trans. Ent. Soc. Lond., 1886, p. 348.
[10] Proc. U. S. Nat. Mus., vol. 23, 1900, p. 91.
[11] Zeitschr. Syst. Hym. Dip., Jahrg. 6, Heft 1, 1906, p. 82.
[12] Brit. Ichn., vol. 3, 1908, pp. 275–279.
[13] Proc. U. S. Nat. Mus., vol. 23, 1900, p. 59.

The wide divergence of opinion as to the placing of these genera brings up the question of the availability of the first included species as genotypes. The characters used in the present-day keys for the separation of the subfamilies of Ichneumonidae leave much to the discretion of the taxonomist in the placing of species. That Brischke and Thomson or Davis and Ashmead should assign the same species to different subfamilies need cause no surprise, nor does it constitute, in the mind of the present writer, reason for declaring *Oedemopsis pulchricornis* Brischke unavailable as genotype of *Hybophanes* nor *Tryphon ? nasutus* Cresson as type of *Campothretus* and *Rhynchothyreus* provided they agree with the original description of the genera otherwise. Unfortunately *Tryphon ? nasutus* does not agree with the original description of *Campothreptus* Foerster in that the ovipositor is not hooked at the tip, and can therefore not function as the type of that genus.[1] This explains the synonymizing of *Campothreptus* Davis but not *Campothreptus* Foerster with *Hybophanes*.

The present writer is of the opinion that Thomson and Schmiedeknecht are more nearly correct in their placing of these three genera than are any of the other writers. The only feature that they display that is antagonistic to the Tryphoninae is the rather strongly exserted ovipositor, and many of their other more important characters are shared in by such genera as *Eclytus* Holmgren and *Perilissus* (Foerster) Holmgren. In the Mesoleptini, where the petiolate abdomen naturally places them, they, however, form a distinct group worthy of at least subtribal rank. This disposition of the three genera together with the new allied genus described below is followed here.

DESCRIPTION OF SUBTRIBE THYMARIDINA SCHMIEDEKNECHT.

Ovipositor exserted, at least as long as first tergite, sheath widened gradually from base to beyond middle, where it abruptly narrows (fig. 2*c*); head behind eyes broad; antennae slender, in female, sometimes in male, white annulate; mandibles narrowed toward apex, upper tooth longer; pronotum with epomiae strong to dorsal margin where they form an angle on each side; notauli distinct to beyond middle of mesoscutum where they coalesce in an impressed area; sternauli more or less distinctly indicated; propodeum completely, through sometimes weakly, arcolated, areola usually long and narrow, petiolar area short, at most embracing slightly less than half the length of the propodeum; wings without an arcolet; radius originating beyond middle of stigma; second recurrent straight; nervellus broken far below middle and distinctly antefurcal; legs slender, claws minute, mutic; hind metatarsus at least as long as three following joints united, last joint but little longer than penultimate; first tergite petiolate or subpetiolate, more or less decurved,

[1] See discussion on this point in Proc. U. S. Nat. Mus., vol. 55, 1919, p. 518.

with deep fovea laterally between spiracles and base, spiracles either slightly before or beyond middle.

The following key will serve to separate the three genera already described and the new genus.

KEY TO GENERA.

Clypeus very large, in female beak-like or nose-like protuberant, in male as long as wide, evenly convex; malar space long; scutellum flattened, carinate to apex..1.

Clypeus not especially large, in female not protuberant, in both sexes much shorter than wide; malar space almost obliterated; scutellum strongly convex, carinate only at base.....2.

1. Spiracles of first tergite before middle, lateral fovea near base; propodeal carinae faint; clypeus in female beak-like basally, deeply excavated apically, in male not longer than face nor densely pubescent (fig. 1).....*Hybophanes*.

Spiracles of first tergite beyond middle, lateral fovea distant from base; propodeal carinae strong; clypeus in female nose-like, not deeply excavated below middle, in male longer than face, strongly convex and densely pubescent (fig. 2).....*Zagryphus*, new genus.

2. Abdomen subpetiolate, first segment not much longer than second, spiracles somewhat before the middle, lateral fovea very near base; tergites densely punctate, opaque.....*Neliopisthus*.

Abdomen distinctly petiolate, first segment much longer than second, spiracles behind middle, lateral fovea distant from base; tergites shining, first and second striate.....*Thymaris*.

Genus HYBOPHANES (Foerster) Schmiedeknecht.

Hybophanes FOERSTER, Verh. Nat. Ver. Preuss. Rheinl., vol. 25, 1868, p. 166. No species included.

Oedemopsis TSCHEK, Verh. Zool.-Bot. Ges. Wien, vol. 18, 1868, p. 276.

Type.—(*Oedemopsis rogenhoferi* Tschek) = *Hybophanes scabriculus* (Gravenhorst). Monobasic.

Oedemopsis TSCHEK, Brischke, Deutsche Ent. Zeitschr., vol. 21, 1887, p. 285–286, pl. 2, figs. B1–B6.

Hybophanes (Foerster) SCHMIEDEKNECHT, Zool. Jahrb., vol. 3, 1888, p. 435. Three species.

Type.—*Tryphon scabriculus* Gravenhorst. By designation of Viereck, 1914.

Campothreptus DAVIS, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 247. (Not Foerster).

Type.—*Tryphon* ? *nasutus* Cresson (*not* Mesoleptus ? *nasutus* Cresson, as designated by Viereck, 1914). Isogenotypic with *Rhynchothyreus* Ashmead.

Zarhynchus ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, 1900, p. 59. (Not Oberholzer).

Type.—*Tryphon* ? *nasutus* Cresson.

Rhynchothyreus ASHMEAD, Can. Ent., vol. 32, 1900, p. 368. New name for *Zarhynchus* Ashmead, preoccupied.

Oedematopsis MORLEY, Brit. Ichn., vol. 3, 1908, p. 258 and 268.

This genus has been described in considerable detail by Tschek,[1] in which place he corrects some errors of his original description and adds some characters of the male; and also by Schmiedeknecht.[2]

Viereck was in error when he fixed as genotype of *Campothreptus* Davis, *Mesoleptus* ? *nasutus* Cresson. This species was included by name only by Davis, apparently under the mistaken idea that it is

[1] Verh. Zool.-Bot. Ges. Wien, vol. 20, p. 428.

[2] Opusc Ichn., fasc. 32, p. 2504.

synonymous with *Tryphon ? nasutus*, the species he had before him. The type of *Campothreptus* Davis is therefore *Tryphon ? nasutus* Cresson.

The only North American species that has been described is *Hybophanes nasutus* (Cresson), redescribed in more detail by Davis.

HYBOPHANES NASUTUS (Cresson).

Tryphon ? nasutus CRESSON, Trans. Amer. Ent. Soc., vol. 2, 1868, p. 107, female.
Campothreptus nasutus (Cresson) DAVIS, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 247, female.
Zarhynchus nasutus (Cresson) ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, 1900, p. 59.
Rhynchothyreus nasutus (Cresson) ASHMEAD, Can. Ent., vol. 32, 1900, p. 368. (The species not mentioned by name, *Rhynchothyreus* being here proposed to replace *Zarhynchus* Ashmead, precoccupied.)
Plectiscidea (*Campothreptus*) *nasuta* (Cresson) VIERECK, Hym. Conn., 1917, p. 276.

This species differs in some respects from Schmiedeknecht's description of the genus, as follows: Antennae distinctly shorter than the body; eyes in female slightly convergent below, in male parallel; second and third tergites nearly quadrate, not or barely longer than wide; fourth tergite as well as the first three distinctly though more weakly sculptured.

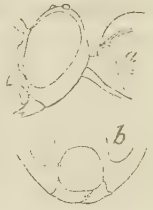


FIG. 1.—HYBOPHANES NASUTUS (CRESSON). *a*. FEMALE. LATERAL VIEW OF HEAD. (*e.*= EPOMIA.) *b*. MALE. FRONT VIEW OF CLYPEUS.

The male has not been heretofore described. It differs from the female principally in having the clypeus flattened medially and broadly rounded apically; the mesoscutum brighter rufous; the antennae without annulus; and the legs paler throughout.

The United States National Museum collection contains three specimens, a female from Lake Placid, New York; a male from Canada; and another female without locality.

ZAGRYPHUS, new genus.

Differs from *Hybophanes* (Foerster) Schmiedeknecht principally as follows: Head not wider than thorax; clypeus nearly twice as long as face, in female nose-like protuberant, weakly impressed below, shining with sparse setigerous punctures, face elevated in middle to level of clypeus; clypeus in male strongly convex, densely punctate, and, together with the medially protuberant face, sides of frons and vertex and posterior orbits, densely griseo-pubescent; antennae of both sexes broadly white annulate; thorax rather densely punctate and pubescent, notauli weak; propodeum with sharp carinae, basal areas polished, nearly impunctate, pleural areas densely punctate, median and apical areas transversely rugose; basal joint of hind tarsus longer than remaining joints combined; nervellus antefurcal;

transverse cubitus barely a sixth as long as basal abscissa of radius (in *Hybophanes* it is fully a fourth as long); basal abscissa of radius more than half as long as apical abscissa; abdomen subcompressed at apex, the apical segments retracted, first tergite much longer than second, spiracles distinctly behind middle, lateral fovea far from base, postpetiole and second tergite longitudinally rugulose, third very weakly so; ovipositor as long as first tergite.

Type.—*Mesoleptus ? nasutus* Cresson.

ZAGRYPHUS NASUTUS (Cresson).

Mesoleptus ? nasutus CRESSON, Trans. Amer. Ent. Soc., vol. 2, 1868, p. 103. Male and female.

This is the only described North American species. It is easily recognized from the generic description and from the original description.

There are two females and one male in the United States National Museum collection—the females from Chain Bridge, Virginia (H. B. Kirke), and Cabin John, Maryland (R. M. Fouts), and the male from Lawrence, Kansas (Hugo Kahl), all determined by the writer and S. A. Rohwer. These specimens are the basis of the generic description.

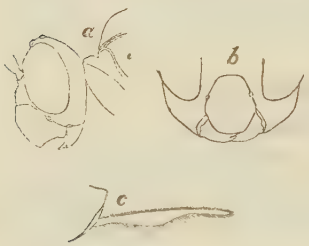


FIG. 2.—ZAGRYPHUS NASUTUS (CRESSON). *a*. FEMALE. LATERAL VIEW OF HEAD. (*e.*=EPOMIA.) *b*. MALE. FRONT VIEW OF CLYPEUS. *c*. SHEATH OF OVIPOSITOR. LATERAL VIEW.

Genus NELIOPISTHUS Thomson.

Neliopisthus THOMSON, Opusc. Ent., fasc. 9, 1883, pp. 907, 908.
Type.—*Phytodietus elegans* Ruthe.
Polysphinctomorpha ASHMEAD, Proc. U. S. Nat. Mus., vol. 33, 1900, p. 59.
Type.—*Polysphinctomorpha luggeri* Ashmead MS.

No specimen of the genotype has been available for study, but that the three species described below belong here there is no doubt, especially since one of them differs in very little from Schmiedeknecht's description of the genotype and may even be that species.

Judging from the three species studied Schmiedeknecht's description of the genus [1] will need a few alterations. The areolation of the propodeum is subject to considerable variation: The areola varies from twice as long as broad and pentagonal (Schmiedeknecht) to as broad as long and hexagonal; the petiolar area is sometimes nearly half as long as the propodeum and sometimes much shorter. That portion of the cubitus lying between the intercubitus and the second recurrent is not always longer than the intercubitus. These and the comparative length and breadth of the tergites are specific characters. The white markings of the head and thorax are apparently of generic significance.

[1] Opusc. Ichn., fasc. 32, p. 2506.

KEY TO FEMALES OF NORTH AMERICAN SPECIES.

General body color fulvous or ferruginous.....*luggeri* (Ashmead)
General body color black.....1
1. Mesoscutum rufous; postpetiole as long as wide at apex; second tergite fully as long as wide; ovipositor sheath barely longer than first tergite..*similis*, new species
Mesoscutum black; postpetiole much shorter than wide at apex; second tergite wider than long; ovipositor sheath much longer than first tergite.....
nigridorsum, new species.

NELIOPISTHUS SIMILIS, new species.

Differs from Schmiedeknecht's description of the genotype only in the shape of the areola and the length of the petiolar area, both of which characters are included in his generic description, and in having a dark longitudinal mark on the disk of mesoscutum, the pronotum partly, metapleura entirely, and propodeum laterally reddish, and the mesonotum no darker than mesopleura.

Female.—Length, 4.5 mm. Head polished, frons and face weakly punctured; thorax subpolished, weakly punctured, more strongly so on disk of mesoscutum; propodeum laterally and posteriorly punctate, medially polished, areola about two-thirds as wide as long, hexagonal, petiolar area not reaching nearly to middle of propodeum; basal vein weakly curved; second abscissa of cubitus much longer than intercubitus; abdomen densely punctate; postpetiole as wide as long; second tergite as long as wide at apex; ovipositor sheath but little longer than first tergite.

Head piceous black; cheeks, mouth parts, clypeus, face below and at sides, and semicircular spot at top of eye whitish; scape and pedicel below rufous; pronotum black, rufous laterally, dorsal and ventral margins white; an elongate spot between notauli blackish; thorax otherwise rufous; propodeum blackish, rufous laterally; legs stramineous, front and middle coxae and all trochanters white, hind tibiae white with obscure apical and subbasal dark annuli; abdomen blackish, tergites apically rufous.

Type-locality.—Wood County, West Virginia.

Type.—Cat. No. 22001, U.S.N.M.

Described from one female captured by Dr. A. D. Hopkins on a gooseberry bush May 2, 1891, and recorded under his West Virginia No. 3200.

NELIOPISTHUS NIGRIDORSUM, new species.

Differs from *similis* principally as follows:

Female.—Length, 4 mm.

Head and thorax more strongly and densely punctate; propodeum more strongly sculptured, areola as well as petiolar area transversely rugulose; basal vein strongly curved; postpetiole wider at apex than

long; second tergite much wider than long; ovipositor sheath about a half longer than first tergite.

Face almost entirely white; pronotum and mesoscutum, except for white markings, black; postscutellum and propodeum entirely black; legs with same color pattern, but pale testaceous rather than stramineous and with dark markings of hind tibiae larger.

Type-locality.—Mount Washington, New Hampshire.

Type.—Cat. No. 22002, U.S.N.M.

Described from one female taken by Mrs. Annie T. Slosson.

NELIOPISTHUS LUGGERI (Ashmead).

Polysphinctomorpha luggeri ASHMEAD MS., Proc. U. S. Nat. Mus., vol. 23, 1900, p. 59.

This species was not described by Ashmead, but was merely mentioned by him as type of the genus *Polysphinctomorpha*.

Differs from *similis* principally as follows:

Female.—Length, 4 mm.

Head and thorax more strongly punctate; propodeum more strongly sculptured, areola rugoso-punctate, nearly as broad as long, petiolar area reaching very nearly to middle; basal vein strongly curved; second abscissa of cubitus barely longer than intercubitus; post-petiole wider at apex than long; ovipositor sheath distinctly longer than first tergite.

General color fulvous to ferruginous; head with occiput, vertex and frons medially black; face almost entirely white; scape and pedicel beneath white; pronotum medially and prescutum anteriorly black; propodeum basally piceous; legs testaceous, front and middle coxae and trochanters yellow and hind trochanters paler, hind tibia at apex and all tarsi fuscous; tergites apically narrowly yellow; ovipositor sheath black.

Male.—Differs from female as follows: Black with same color pattern as female; antennae not annulated; eyes not convergent below; intercubitus longer than second abscissa of cubitus; abdomen somewhat more slender, the postpetiole not wider than long; hind coxae more or less piceous; hind tibiae more strongly infuscate.

Type-locality.—Minnesota.

Type.—Cat. No. 22003, U.S.N.M.

Described from one female labeled by Ashmead "*Polysphinctomorpha luggeri* Ashm.," and three females and two males reared March 17, 1883, from a tineid larva on *Comptonia* without locality or collector's name, but probably reared in Missouri by Miss Mary E. Murtfeldt.

The type is apparently not fully matured and is paler throughout, the normal color being probably ferruginous rather than fulvous.

The three female paratypes have the first tergite in the middle and the others more or less at base piceous.

Genus THYMARIS (Foerster) Brischke.

Only one North American species has been referred to this genus. This is *Thymaris slingerlandana* Ashmead. It does not belong to the genus but is a Campoplegine synonymous with *Dioctes obliteratus* (Cresson).

The following new species is apparently the first North American species truly referable to the genus.

THYMARIS AMERICANUS, new species.

In Schmiedeknecht's key to the European species of *Thymaris* runs to *collaris* Thomson and agrees fairly well with the description, but lacks the brown color on the metapleura. The description of *collaris* is, however, based entirely on color and size, and is so brief that it is inadvisable to determine an American species as *collaris*, especially without a specimen of that species for comparison.

Female.—Length, 4 mm.; antennae, 4 mm.

Head polished, weakly, sparsely punctate, more densely and strongly so on face and frons; temples narrow, convex; clypeus finely punctate; thorax sparsely punctate, more strongly and densely so on disk of mesoscutum and metapleura; propodeum punctate basally transversely rugulose apically, areola and petiolar area equal in length, the former hexagonal with costulae at its basal third; hind basitarsus very nearly as long as remaining joints combined; second abscissa of cubitus barely longer than intercubitus; first three tergites longitudinally striate, the third more weakly so.

Black; clypeus and mandibles yellow; palpi white; antennae black, flavous at base, flagellar joints 9-12 white; thorax black, with pronotum laterally, mesopleura in dorso-anterior corner, disk of mesoscutum and scutellum reddish; tegulae stramineous; legs stramineous, front and middle coxae and trochanters white, hind tibiae slightly infuscate apically and subbasally; abdomen black with apices of first three tergites reddish.

Male.—Length, 4 mm.; antennae, 5 mm.

Differs from female principally as follows: Head wider and more strongly convex behind eyes; antennae black without annulus and with only scape and pedicel yellowish; prothorax mostly black, mesopleura only obsoletely red dorso-anteriorly; mesoscutum and scutellum entirely black; hind tibiae and tarsi generally infuscate.

Four female paratypes show color variation both ways from the type. Paratypes *a* and *b* have the red of the thorax brighter and more extensive, the discal spot on mesoscutum of *a* embracing most

of prescutum. These two also have the second tergite nearly half flavous. Except for the antennae paratype *d* is colored almost like the male paratype *i*. Five male paratypes show very little variation from the allotype, *i* only having a trace of the red on mesoscutum.

Type-locality.—Rosslyn, Virginia.

Other locality.—Georgetown, District of Columbia.

Type.—Cat. No. 22004, U.S.N.M.

Described from the above eleven specimens, all collected by H. H. Smith.

A STUDY OF THE BRACHIOPOD GENUS PLATYSTROPHIA

By Eula Davis McEwan,
Of Northwestern University, Evanston, Illinois.

INTRODUCTION.

The brachiopod genus *Platystrophia* [1] is of interest because of the abundance of its species and the great variation exhibited in their development. Early investigators differed considerably as to the relationships of this group of brachipods and referred its species to *Terebratulites*,[2] *Terebratula*,[3] *Porambonites*,[4] *Atrypa*,[5] *Spirifer*,[6] and *Delthyris*.[7] The peculiar granular surface and general outline of the shell led most early writers to refer its species to *Spirifer* and *Delthyris*, but the intimate structure is clearly distinct from all of these genera.

In 1848 Davidson demonstrated [8] that the internal characters of this group of shells were those of *Orthis* and several contemporary investigators followed his interpretation. In 1850 King [9] proposed the name *Platystrophia* for this group of Orthids with *Terebratulites biforatus* Schlotheim as the type. In America early investigators referred these shells to *Delthyris* and *Spirifer*,[10] and later to *Orthis*.[11]

[1] Πλατυς, wide; στροφειν, to turn (as a hinge).

[2] Schlotheim, Petrefaktenkunde auf ihr jetz. Standpunkt, 1820, p. 265.

[3] Von Eichwald, Nt. Schizze von Polodien, 1830, p. 202.

[4] Pander, Beitr. zur Geognosie Russlands, 1830, p. 96.

[5] Hisinger, Lethaea Suecica, 1837, p. 76.

[6] Von Eichwald, Silurische Schichten-System von Estland, 1840, p. 144.—Castelnau, Essai sur le Syst. Silur. de l'Amérique septentrionale, 1843, p. 42.—Phillips and Salter, Mem. Geol. Surv. United Kingdom, vol. 2, 1848, p. 293.—McCoy, British Palaeoz. Fossils, 1852, p. 192.

[7] De Verneuil, Géol. de la Russie, vol. 2, 1845, p. 135.—McCoy, Syn. Silur. Fossils Ireland, 1846, p. 37.

[8] Davidson, Bull. Soc. Géol. France, ser. 2., vol. 5, 1848, p. 323.—Quenstedt, Handb. der Petrefactenkunde, 1851, p. 486.—Davidson, Introduction British Foss. Brachiopods, pl. 8, 1853, figs. 146–148.—Salter, Murchison's Siluria, ed. 2, 1859, p. 210.—Lindstrom, Gotland's Brachiopoder, 1860, p. 371.—Salter, Mem. Surv. United Kingdom, vol. 3, 1866, pp. 259, 267, 276.—Davidson, British Silurian Brachiopoda, 1871, p. 268.

[9] Mon. Permian Fossils England, p. 106.

[10] Emmons, Geol. New York, Rep. Second Dist., 1842, p. 396.—Conrad, Journ. Acad. Nat. Sci. Philadelphia, vol. 8, 1842, p. 260.—Hall, Geol. New York, Rep. Fourth Dist., 1843, p. 70.—Owen, Geol. Expl. Iowa, Wisconsin, Illinois, 1844, pl. 15.—Hall, Nat. Hist. New York, Pal., vol. 1, 1847, p. 131; vol. 2, 1852, p. 192.—Rogers, Geol. Pennsylvania, vol. 2, 1858, p. 820.

[11] Billings, Canadian Nat. Geol., vol. 1, 1856, p. 206.—Hall, Twelfth Rep. New York State Cab. Nat Hist., 1859, p. 66.—Billings, Geol. Canada, Rep. Prog., 1863, p. 167.—Nicholson and Hinde, Canadian Journ., 1874, p. 158.—Meek, Geol. Surv. Ohio, Paleont., vol. 1, 1873, p. 114.—James, Cincinnati Quart. Journ. Sci., vol. 1, 1874, p. 20.—White, Geogr. and Geol. Expl. west 100th Merid., 1875, p. 74.—Nicholson, Rep. Pal. Prov. Ontario, 1875, p. 16.—Miller, Cincinnati Quart. Journ. Sci., vol. 2, 1875, p. 25.—James, The Paleontologist, No. 1, 1878, p. 7.—White, Second Ann. Rep. Indiana Bur. Stat. and Geol., 1880, p. 437; Tenth Rep. State Geol. Indiana, 1881, p. 119.—Foerste, Bull. Sci. Lab. Denison Univ., vol. 1, 1885, p. 80.—Nettelroth, Kentucky Fossil Shells, 1889, p. 35.

It was not until after 1883 that King's term *Platystrophia* came into general use.[1]

Several recent investigators have added much to our knowledge by their specific interpretations, among whom Prof. E. R. Cumings and Dr. A. F. Foerste[2] are most prominent. Professor Cumings published a detailed study on the Morphology of the Genus[3] which brought out the fundamental lines of evolution and variation. The aim of the present paper is to corroborate and add some facts to the work which he has done.

The mutability of species has been accepted by most investigators since Darwin published his "Origin of Species" in 1859. However, many systematists to-day find difficulty in including more than one species in a well-graded series, even though the extremes are quite different. When individuals possessing common characteristics and possessing the tendency to acquire certain other characteristics are subjected to varying influences they develop differentially. This results in groups which differ to a greater or less degree. These groups are regarded by the writer as species.

The material on which this study is based belongs for the most part to the United States National Museum. It consists of about 4,000 specimens from various points in North America and Europe. The specimens were mainly from the Ulrich collection, with additions made in recent years by various members of the museum paleontological staff.

In addition to these, several hundred Platystrophias from the Paleontological Museum of Columbia University were at the writer's disposal. Dr. A. F. Foerste also kindly presented about 500 specimens from the Ohio Valley and from Michigan to the United States National Museum in order to further the present study.

With the fullest appreciation of Professor Cumings's work on the "Morphogenesis of Platystrophia" the writer gladly acknowledges her indebtedness to him for the inspiration received from that valuable work. He has also been of great service in offering helpful suggestions and criticisms. Acknowledgments are extended to Dr. E. O. Ulrich, of the United States Geological Survey, who supplied information which could not be secured from any other source. The writer desires to express her appreciation to Dr. R. S. Bassler, curator of

[1] Zittel, Handb. Pal., vol. 1, 1880, p. 675.—Hall, 36th Rep. N. Y. State Mus. Nat. Hist., 1883, p. 34; Rep. N. Y. State Geol. for 1882, 1883, p. 34.—Waagen, Mem. Geol. Surv. India, Pal. Indica, ser. 13, vol. 1, 1884, p. 549.—Shaler, Mem. Kentucky Geol. Surv., vol. 1, pt. 3, 1887, pp. 43, 44.—Hall, Bull. Geol. Soc. America, vol. 1, 1889, pp. 19, 20.—Hall and Clarke, Pal. New York, vol. 8, pt. 1, 1892, p. 200.—Winchell and Schuchert, Geol. Minnesota, vol. 3, 1893, p. 454.—Hall and Clarke, Eleventh Ann. Rept. New York State Geol., 1891, p. 268.—Koken, Die Lietfossilien, Leipzig, 1896, p. 235.—Schuchert, Bull. U. S. Geol. Surv., 87, 1897, p. 308.—Wysogorski, Zeits. d. d. Geol. Gesell., vol. 52, 1900, p. 234.—Cumings and Mauck, Amer. Journ. Sci., ser. 4, vol. 14, 1902, p. 9; Cumings, Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 1.—Grabau and Shimer, N. A. Index Fossils, vol. 2, 1907, p. 257.—Cumings, Thirty second Ann. Rep. Dep. Geol. Nat. Res. Indiana, 1908, p. 891.—Schuchert, Zittel Eastman Textb. Pal., 1913, p. 381.

[2] Bull. Sci. Lab. Denison Univ., vol. 1, 1885, p. 80.

[3] Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 1.

paleontology, United States National Museum, for his suggestions and criticisms in the preparation of the paper. The writer is under deep obligations to Prof. A. W. Grabau of Columbia University, under whose direction this study was begun.

GENERIC CHARACTERISTICS.

Most paleontologists have based their classifications on adult characters alone. If a classification is to express generic relationship and not merely represent a group of morphological equivalents, the early growth stages must not be neglected, and should indeed be regarded with great care.

The writer was unable to secure young specimens of *Platystrophia*. Professor Cumings has, however, demonstrated [1] that a specimen between 0.66 mm. and 1 mm. in length was "markedly transverse, the greatest breadth about one-third of the way from the beaks to the front margin. The posterior margin (cardinal line) is straight, and the anterior semielliptical. The greatest height is at the beaks which project slightly beyond the area, but are not incurved. The area is considerably less than the width of the shell at the hinge, and the large foramen is about equally shared by the two valves. At the apex of the ventral foramen is a small callosity. No deltidium was observed." The young stages are well preserved in many adult specimens and thus furnish a permanent record of the entire life history. These specimens show a smooth shell next to the beak. Very soon, however, plications appear, eight on the brachial valve and nine on the pedicle valve. The furrow separating the two centrally located plications of the brachial valve is deeper than the others and forms a median sinus, and the centrally located plication on the pedical valve is larger than the others and forms a fold.

This development is followed by the depression of the area occupied by the pedicle fold and the elevation of the area occupied by the brachial sinus thus forming the true pedicle sinus and brachial fold. The early nepionic fold becomes a plication occupying a median position in the true sinus and the two plications bordering the early nepionic sinus become plications on the true fold.[2]

In discussing this development Winchell and Schuchert say, "* * * In several immature individuals it has been observed that in the early neologic stage the beaks are strongly elevated, probably erect, and each has a very large open delthyrium, surface smooth at first, but gradually developing eight plications and a mesial sinus in each valve. The sinus in the dorsal valve is bounded

[1] Amer. Journ. Sci., ser. 4, vol. 15, 1903, pp. 2-4.

[2] For a detailed discussion of the early stages of the genus see Cumings, Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 3.

by two elevations which become plications and between them is soon developed a single costa which immediately bifurcates. The four plications increase in strength and become strongly elevated as they proceed to the anterior margin producing the conspicuous fold of this valve." [1] Mature specimens which have well preserved beaks show the presence of a distinct fold on the pedicle valve and a distinct sinus on the brachial valve in early nepionic development as was first pointed out by Professor Cumings.

During the early neanic stage the shell takes on group characteristics. These groups will be described later as the Uniplicate, Biplicate, and Triplicate Groups.

In late neanic and early ephebic development the changes which take place vary with different species and are of specific, varietal, or individual value.

Adult specimens show the hinge-line to be long and straight. Generally it about equals the width across the middle. A few species have the hinge-line much less and a few others much greater than the width farther forward. The cardinal areas are common to both valves and are about equally developed. That of the pedicle valve is generally somewhat the broader. Each valve has an open delthyrium, of which the one in the pedicle valve is the larger.

The teeth are thick and prominent. In the brachial valve a cardinal process is sometimes present as a short, slender, vertical ridge in the roof of the open delthyrium. The dental sockets are small and the crural plate large and strong. The muscular scars are usually excavated into the shell substance. They are small and are not easily separable into their respective parts. An exception is found in *Platystrophia ponderosa*, in which the scars are separated by a septum in the brachial valve, extending toward the front as a low ridge and dying out before reaching the front.

About one-third of the distance from the beak the septum sends off ridges at right angles to the general direction of the septum (pl. 52, fig. 10).

Both valves are convex. They vary from flatly to strongly convex. The brachial valve may about equal the convexity of the pedicle valve, but it is generally greater. This valve carries a median fold, which may be broad, round, or flat, and but slightly raised above the general convexity of the valve; it may be broad, round, and much elevated, or it may be compressed and greatly elevated above the general convexity.

The pedicle valve has a median sinus, which may be broad and shallow, broad and deep, or narrow and deep. In some species the depth of the sinus is in proportion to the height of the fold, but some

[1] Geol. and Nat. Hist. Surv. Minnesota, vol. 3, pt. 1, 1893, p. 456.

specimens show that the sinus is proportionally deeper than the height of the fold. This is accomplished by the compression of the pedicle valve, which results in a greater elevation of the slopes next to the sinus.

With few exceptions the surface of both valves is marked by strong plications, which are generally sharp. *Platystrophia fernvalensis*, new species, from the Fernvale of Cape Girardeau, Missouri, is striated, but next to the beak these striae merge into broad plications. The genus is extremely variable in form, size, and number of plications. Form and size are reasonably constant, but the number of plications varies considerably within the limits of the species.

The surface layer of the shell is finely granulose. This feature is not always evident if the surface layer has been subject to abrasion. The inner surface is finely punctate.

Old age is indicated by increase in gibbosity, thickening of the shell, strong growth varices, and loss of characters of low taxinomic rank.

TYPE OF THE GENUS.

King took as the type of his genus, *Terebratulites biforatus* Schlotheim. This species was described in 1820 as follows: "Mit ganz gleichen, breiten, länglichrunden Hälften, deren Schnäbel gleichförmig gewölbt und auf beyden Seiten durchbohrt sind. Die Oberschaale mit einer breiten concaven Rückenfurche, die untere Hälfte mit convex hervorstehenden Rücken. Beyde Hälften gleichförmig der Länge nach gestreift, mit ziemlich tiefen Zwischenfurchen. Ausserordentlich selten."[1]

Schlotheim's type material consisted of one specimen which was not figured. His description is too general for application to any particular species, and as a result paleontologists have not been able to come to any definite conclusion as to the specific denomination of the shell.

M. de Verneuil says[2] that Von Buch saw Schlotheim's type in the Berlin Museum, and reported the distinctive characters to be the presence of five ribs in the sinus, and the width proportionally greater than the other species of the genus then known. There are individuals of nearly every species and every variety of this genus which have four, five, or more plications in the sinus, and transverse forms are common. There are subquadrate specimens with five plications in the sinus and transverse specimens with five plications in the sinus, so that the characteristics cited are not sufficient to constitute a species.

[1] Schlotheim, Die Petrifactenkunde auf ihrem jetzigen Standpunkte durch die Beschreibung versteinerter Schalle, 1820, p. 265.

[2] De Verneuil et De Keyserling, Geol. Russia, vol. 2, p. 138.

Davidson says: "We certainly have the type *biforata* and the variety *lynx*, but these two seem with us so intimately connected that I have combined them under Schlotheim's single designation; * * *"[1]

Davidson figures [2] his specimens as *Platystrophia biforata* and varieties of that species. The origin of the plications of the fold and sinus as shown in figs. 11, 11*a*, 11*b* is distinctly different from that shown in figures 12, 14, 15, 25. The origin of the plications of the other specimens is not determinable with certainty. This difference in origin is of great importance as it takes place very early in the development. Members of the same species would necessarily have a uniform ontogeny.

McCoy describes *Platystrophia biforata* as "having the mesial fold wider, and less elevated, bearing usually from six to nine ribs, at six lines or less from the beak, and five to seven in the sinus; the lateral ribs narrow, simple and from nine to twelve on each side, at six lines from the beak."[3] This description does not define any particular form as there are individuals of nearly every species of the genus which show this characteristic.

As it is impossible to determine what Schlotheim's type-specimen was it can not stand as a type of the genus. *Platystrophia laticosta* Meek is well known to all investigators of Ordovician paleontology. As it possesses all the qualities necessary for a genotype, it is suggested that future workers regard it as such.

RELATION TO OTHER ORTHIDS.

Professor Cumings has shown that the nepionic development of *Platystrophia* is identical with that of *Orusia lenticularis* variety *lycoides* Matthew and concludes that that species is the ancestor of the genus.[4]

Eoorthis of the Upper Cambrian has the physiognomy of this genus and has been confused with it. This resemblance is of little importance. It is, however, of interest that in this genus the sinus is in the brachial valve and the fold on the pedicle valve. This recalls the early development of *Platystrophia*, in which the pedicle valve bore a fold and the brachial valve a sinus. In Monograph 51, United States Geological Survey (pl. 93, fig. 3), *Eoorthis? diablo* (Walcott) is represented. The specimen seems to have been smooth at the beak. Very near the beak broad undulations arise and extend to the frontal margin. This agrees with the early nepionic development of *Platystrophia* and further investigation is likely to bring to light close relationships between the two genera.

The resemblance of *Plectorthis* to *Platystrophia* has also been demonstrated by Professor Cumings.[5] He says: "If the sinus and

[1] British Fossil Brachiopoda, 1851–1855, p. 271.
[2] Idem, pl. 38.
[3] British Pal. Fossils, pp. 192, 193.
[4] Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 5.
[5] Idem, p. 11.

fold are disregarded, the neanic *Platystrophia* is almost a *Plectorthis*. There is little doubt that when the nepionic shell of *Plectorthis* is discovered it will be found to be quite indistinguishable from the nepionic shell of *Platystrophia*, since the two present at the beaks almost identical characters. * * * *Plectorthis* may therefore represent an offshoot from the *Platystrophia* group near its initiation or, as suggested above, it may have been separately derived from the *Orthis lenticularis* stock."

Beecher has shown that *Platystrophia* has all the characters necessary for the ancestor of *Bilobites*.[1] Professor Cumings carried this investigation somewhat further and found that the nepionic stage of *Bilobites* is almost identical with that of *Platystrophia crassa* in everything except size. He says: "The median plication of the sinus of uniplicate and triplicate types of *Platystrophia* is a character that is never absent, whatever other modifications may affect the shell; the presence of this persistent character in a derived genus is to be expected, and affords, together with the evidence from development, a virtual demonstration of the derivation of *Bilobites* from *Platystrophia*."[2] The ancestor of *Bilobites* must have been uniplicate and he regards *Platystrophia crassa* as the most likely ancestor.

As specialized forms of this species are taking on declining characters, it is likely that *Bilobites* originated from one of the least specialized members.

GROUPS AND SUBGROUPS OF THE GENUS.

On the basis of certain neanic characteristics the species of *Platystrophia* were found to be separable into three groups which Professor Cumings has called the *Uniplicate*, *Biplicate*, and *Triplicate* types.[3]

1. *Uniplicate group.*—In the uniplicate group the one plication in the sinus and two on the fold, at the end of the nepionic stage of development, continue unmodified throughout the entire life history, and there is no further modification of the fold and sinus except that both these parts and the plications which they bear become broader as they approach the frontal margin.

2. *Biplicate group.*—In the biplicate group the median plication of the sinus bifurcates while on the fold a plication is intercalated in a median position. Some members of this group do not show a further development and are regarded as a subgroup which the writer will later refer to as subgroup A.

In subgroup B the bifurcation of the plication in the sinus is soon followed by the intercalation of a plication in a median position while on the fold the median secondary plication bifurcates.

In subgroup C the bifurcation of the primary plication in the sinus is followed by the implantation of a plication on each of the lateral slopes while on the fold, the two primary plications bifurcate.

[1] Amer. Journ. Sci., ser. 4, vol. 42, 1895, pp. 51–56. [2] Idem., vol. 15, 1903, p. 40. [3] Idem, p. 10.

In subgroup D a plication is intercalated in a median position in the sinus and a lateral plication is implanted on each of the slopes, while on the fold all the plications bifurcate.

3. *Triplicate group.*—The greater number of North American species belong to the triplicate group. In this group the primary plication remains unmodified throughout the life history. In the early neanic stage a plication is implanted on each slope of the sinus, the one on the right side appearing first. Contemporaneous with this development the two primary plications of the fold bifurcate and form four plications.

The triplicate group was found to be separable into three subgroups which the writer is designating, the low fold, the high fold, and the Ponderosa subgroups. The first two subgroups are alike in possessing a long hinge line relative to the height. By a comparison of the growth stages both are found to pass through a similar development in the nepionic and early neanic stages. In the low fold subgroup the low rounded fold persists throughout its development and the plications of the fold and sinus remain of nearly the same strength. The second subgroup in the late neanic stage develops a high compressed fold on which the lateral plications become weak and tend to disappear, giving the fold an angular appearance.

Some individuals and varieties belonging to species of the low fold subgroup have slightly elevated folds, on which the lateral plications are somewhat weakened. This may be an expression of an innate tendency of the race to develop a high fold which was somewhat realized when the organism was subjected to the proper environmental stimulation.

Those species and varieties which are characterized by large size are placed in the *Ponderosa* subgroup.

These large *Platystrophias* have been called *Platystrophia lynx* or *Platystrophia biforata*, according as they were interpreted by the investigator.

Platystrophia biforata has been discussed in the preceding pages and it has been shown that the term is of no specific value.

In 1830 Eichwald[1] described *Terebratula* (*Platystrophia*) *lynx* as follows: "Spirifer, cardine elongato, recto, vertice, utriusque valvae prominulo, utraque valva sulcata, stratis singulis transversis ex testae incremento exortes, numerosissimis margine dentato; media parte unius valvae prominula, quadrisulcata, alterius vero parte eadem exclavata, profunda."

Eichwald's specimen was from the drift and was not figured. The description is not specific enough to delineate a species and accordingly is of no value.

Several hundred specimens were before the writer and an endeavor was made to find some logical classification of them. There are

[1] Skizze von Podolis, p. 202.

gibbous, subquadrate forms with the hinge about equaling the width; these represent the species described by Doctor Foerste as *Platystrophia ponderosa* and seem to be confined to the Bellevue. There are globose forms found in the Mount Auburn which Foerste has described as *Platystrophia ponderosa auburnensis;* and there is an unusually large transverse form confined to the Arnheim formation which the writer is describing as *Platystrophia ponderosa arnheimensis.* But there are innumerable variants which refuse to mark any definite horizon and before they can be of any use to stratigraphy further data are needed.

RELATION OF THE GROUPS.

As the uniplicate stage is common to all *Platystrophias,* it is evident that there was a uniplicate ancestor with three and four plications on the lateral slopes. The species most closely related to this ancestral form is *Platystrophia uniplicata,* new species, from the New York Lower Trenton. That this is not a retrograde from the triplicate group is shown by the fact that none of the many specimens associated with it showed a tendency toward loss of the lateral plications of the fold and sinus. There is a uniplicate species in the Lower Trenton of Europe, but this form is gibbous and has a more specialized fold and sinus.

Divergence from the uniplicate stock must have taken place in early Ordovician or Upper Cambrian time, as somewhat specialized members of the triplicate group are found in the Black River.

The biplicate group must have diverged at a very early stage in the development of the genus, as the modification of the plications of the fold and sinus takes place before the shell has reached a length of 1 mm.

Subgroup A shows the least differentiation, as the median plication has not appeared in the sinus, and the median plication of the fold has not bifurcated. It therefore stands closer to the ancestral stock than the other subgroups. Its occurrence with the *uniplicate group* and subgroup B does not necessarily mean that differentiation was taking place in Lower Trenton time, but rather that the *uniplicate type* and subgroup A were representatives of the primitive stocks which give rise to the other subgroups in early Ordovician time.

Subgroups B and C diverged from the radical represented by subgroup A about the same time; one added a plication in a median position in the sinus and the other added plications on the slopes. A very little later subgroup D diverged from C by adding plications on the lateral slopes.

As the triplicate group retains the uniplicate condition until the shell has reached a length of 1.2 to 1.5 mm., it must have diverged from the ancestral stock much later than the biplicate group.

All of the Trenton triplicate species except *Platystrophia preponderosa*, new species, belong to the low-fold subgroup, which preserved the low fold and convex form of the ancestral stock. Members of this group persisted into the Maysville, being represented by *Platystrophia juvenis*, new species; *Platystrophia panciplicata*; *Platystrophia strigosa*, new species; *Platystrophia nitida*, new species; *Platystrophia morrowensis; Platystrophia corryvillensis*, new species; and *Platystrophia sublaticosta*, new species. While there were seven species present, four of these were confined to the Lower Maysville and two are limited to narrow horizons in the Corryville. *Platystrophia sublaticosta*, new species, which ranges through the Fairmount, Corryville, and Mount Auburn, has only a scanty representation.

There is an increase in the number of low-fold species in the Richmond. Some of these are so similar to the Upper Trenton members of the genus as to require great care in differentiation. This is especially true of *Platystrophia foerstei*, new species, and *Platystrophia precursor latiformis*, new variety. The Richmond species is distinguished by its somewhat deeper sinus. *Platystrophia attenuatus*, new species, which occurs in the Waynesville at Waynesville, Ohio, has many characters in common with *Platystrophia amoena*, new species, of the Middle Trenton and *Platystrophia juvenis* of the Lower Maysville Group. The Richmond species usually has fewer plications on the lateral slopes. *Platystrophia moritura* of the Upper Richmond is distinguished from *Platystrophia precursor augusta*, new variety, of the Upper Trenton, with difficulty. In all these instances the Richmond species has a somewhat deeper sinus.

The writer is not inclined to regard this similarity of form as being due to reversion to primitive types. The Maysville species had undergone too many changes to leave no record in the ontogeny It seems to indicate a reinvasion of the region by *Platystrophias* from an area where environmental conditions during Lower and Middle Cincinnatian time did not stimulate decided change. This recurrence agrees with Doctor Ulrich's observations on the recurrence of Cathey's corals. He says: "These same corals, or, rather, their scarcely distinguishable descendants, appear once more in the Richmond series of Ohio, Indiana, and Kentucky." [1]

While many of the Richmond members are quite like those of earlier horizons, there are many whose physiognomy is entirely distinct. Such species as *Platystrophia annieana*, *Platystrophia clarksvillensis*, *Platystrophia cumingsi*, new species, and *Platystrophia acutilirata* are decidedly more transverse and their brachial valves are more ventricose than any of the earlier forms. They also tend to have a greater number of plications on the lateral slopes.

Extreme specialization was expressed in the low fold subgroup by the long hinge line and many plications on the lateral slopes. This

[1] Revision of the Paleozoic System, Bull. Geological Soc. America, vol. 22, 1911, no. 3, p. 300.

culmination is followed in the Upper Whitewater by loss of vitality, as is indicated in the excessive deposit of lime, narrowing of the shell, and loss of plications next to the cardinal angles.

The high-fold subgroup passes through an accelerated low-fold development, and in the late neanic stage develops a high compressed fold on which the plications are weak. It has no representatives in the Trenton. There are occasional individuals which have a somewhat higher fold than others, but this seems to represent only an attempt at the realization of a latent tendency which was never fully expressed.

Platystrophia pauciplicata is a *Platystrophia juvenis*, new species, which has lost two of the lateral plications on the lateral slopes. Variants from *Platystrophia pauciplicata* developed a high fold and merged into *Platystrophia profundosulcata* by all degrees of variants.

From some of these variants *Platystrophia crassa* developed. The most abundant mutation of this species has a globose form and high compressed fold and deep sinus, on which the plications are weak. In the mutation which James took as his type the lateral plications of the fold and sinus have disappeared or exist as rudimentary structures next to the beak. Another mutation has only four or five plications on the lateral slopes. These mutations indicate that this species was on the decline, having reached the highest point of specialization in the high fold mutation.

Platystrophia laticosta is a transverse species with a high compressed fold on which the plications are weak. The young of this species resemble *Platystrophia profundosulcata* but the fold is not so high nor the sinus so deep. Index curves and the physiognomy of the shell indicate that *Platystrophia laticosta* developed from one of the high fold variants of *Platystrophia pauciplicata*.[1]

Platystrophia unicostata developed from *Platystrophia laticosta* by all degrees of variants. It marks the culmination of a development toward a high compressed fold on which the lateral plications have disappeared or exist as rudimentary structures next to the beak. But with this high specialization came extinction, as loss of vitality is indicated by the narrowing of the shell, increase in gibbosity, and loss of plications next to the cardinal angles. The variety *crassiformis* marks extreme racial gerontism, as there are only four or five plications on the lateral slopes and the form has become so narrow and gibbous that the thickness equals or is even greater than the width and height.

The physiognomy of *Platystrophia cypha* of the Arnheim formation suggests its development from *Platystrophia unicostata*, but this is not likely, as the latter species is taking on declining characteristics.

[1] Professor Cumings has demonstrated the origin of *Platystrophia crassa* and *Platystrophia laticosta* from *Platystrophia pauciplicata*. Amer. Journ. Sci., ser. 4, vol. 15, p. 23.

It marks a development toward a loss of plications on the lateral slopes, while *Platystrophia cypha* marks the culmination of a development toward an increase in the length of the hinge line and in the number of plications on the lateral slopes. This is accompanied by the development of a high compressed fold and profound sinus on which the lateral plications have disappeared or exist only as rudimentary structures. These characteristics represent the highest degree of specialization reached by the high fold subgroup. The culmination is followed by decline, which is indicated by the development of a galaxy of variants. Those variants, which are tied together by a group of constant characteristics, are described in the following pages as varieties of this species but by far the greater number will permit of no classification.

In the Lower Maysville members of this subgroup were rare. However, from late Fairmount until the end of the Maysville, they form the most conspicuous fossil, being represented by great numbers of *Platystrophia crassa* in the Upper Fairmount, *Platystrophia laticosta*, and *Platystrophia unicostata* in the Bellevue and Corryville and Mount Auburn. At the end of the Maysville most of these species became extinct. *Platystrophia cypha*, however, lived into the Arnheim and became associated with the members of the low fold subgroup, which had migrated into the area.

From a study of the early development of members of the *Ponderosa* subgroup the conclusion was reached that these specimens represent degenerate branches of the genus which originated while the race was still in a progressive state of development.

Platystrophia preponderosa, new species, of the Upper Trenton group, passes through a *Platystrophia precursor* development and then becomes globose. There existed during the Maysville and lower Richmond time a large form with a long hinge line and equiconvex valves, and low spreading fold. The early development of these is almost identical with that of *Platystrophia precursor*. Most of these large *Platystrophias* are globose with the brachial valve much the deeper, and with moderately elevated folds.

The writer's investigation revealed very little as to the origin of this protean group. All of them, however, pass through a low-old development which indicates their origin from some member of that subgroup. It may be that various members possessed the possibility of large size which was realized in one or more lines. When their energy was exhausted, decline was marked by assumption of gerontic characters and the development of multitudinous forms which are so diverse as to permit of little classification.

PARALLELISM IN DEVELOPMENT.

This genus furnishes several examples of convergence in development. The adult members of the most specialized mutations of

Platystrophia crassa and *Platystrophia unicostata crassiformis*, new variety, are narrow globose forms with high-compressed folds and deep sinuses on which the lateral plications are weak or have disappeared. The growth stages and the many variants show that the former is derived from *Platystrophia paniciplicata* while the latter is derived from the *laticosta* stock.

Typical specimens of the adult *Platystrophia unicostata* of the Maysville group find their almost exact equivalent in adult specimens of *Platystrophia cypha bellatula*, new variety, of the middle Richmond, although the Maysville form originated from *Platystrophia laticosta* and the Richmond form from *Platystrophia cypha*.

A comparison of the biplicate and triplicate groups furnishes a good example of parallel development. Belonging to both are retrograde globose species. There are transverse species with high-compressed folds and deep sinuses on which the plications are rudimentary or absent. There are species in both groups with extremely long hinge lines and many plications on the lateral slopes, and there are large ponderosa-like forms.

This seems to indicate that the ancestral species had certain latent possibilities, and though divergence took place early, these possibilities were transmitted to the various groups and subgroups and were expressed in a definite order whenever the appropriate environmental stimulation was present.

PHYLOGERONTIC TYPES.

Platystrophia rhynchonelliformis, new species, of the Lower Trenton; *Platystrophia amoena robusta*, new variety, of the Middle Trenton; and *Platystrophia globossa*, new species, and *Platystrophia preponderosa*, new species, of the Upper Trenton are globose forms which show a tendency to loss of plications next to the cardinal angles. They are phylogerontic members of the genus which have developed while the race was still young.

The *Ponderosa* subgroup, which is abundantly represented in the Maysville group of Indiana, Ohio, and Kentucky, seems to represent the phylogerontic end members of lines from the low fold subgroup, which soon exhausted their energy in assuming large size. Professor Cumings has called it a veritable race of gerontic individuals. The greater number of them have the thickness equalling or exceeding the width and there is obsolescence of plications next to the cardinal angles. An excessive deposit of lime occurs in all of them. These characters point to loss of vigor and mark a return to second childhood.

Another example of phylogerontism is found in *Platystrophia crassa*. *Platystrophia crassa* passes through a long-hinged development and in the late neanic stage takes on gerontic characteristics. The globose tendency becomes so pronounced in this species that the thickness equals or exceeds the height in the adult. Increase in

thickness is accompanied by weakening or loss of the lateral plications of the fold and sinus and those of the lateral slopes next to the cardinal angles.

The globose variety, *Platystrophia unicostata crassiformis* represents a phylogerontic development from *Platystrpohia laticosta* through *Platystrophia unicostata*, and the many narrow paniciplicate variants of *Platystrophia cypha* represent a like development from that species.

In *Platystrophia acutilirata* the shell is so thickened centrally and anteriorly that the space occupied by the soft parts is exceedingly small when compared to the size of the shell. This indicates that this species is the most gerontic of the genus. Both valves are marked by strong growth varices, which in the less specialized forms turn out toward the cardinal extremities.

PATHOLOGIC INDIVIDUALS.

In the Arnheim beds of the Ohio Valley pathologic individuals belonging to the *Ponderosa* subgroup are quite common. They are large, globose, asymmetrical forms frequently with distorted beaks. There is a tendency toward the loss of the fold on one side in some individuals. In others there is a loss of lateral plications of the fold and sinus, and again the plications of the lateral slopes encroach on the fold and sinus in late neanic or ephebic development. This may be accompanied by loss of plications on the lateral slopes next to the cardinal angles, or this development may take place independently.

RECURRENT MUTATIONS.

Typical specimens of the triplicate group have three plications in the sinus and four on the fold. In nearly every species and variety of the triplicate group there are individuals in which there are a greater number. The plications are added in various positions, but, with two apparent exceptions, they originate by implantation in the sinus and bifurcation on the fold. The addition of plications on the fold follows the same order of appearance as occurs in the sinus.

Hugo de Vries has shown that some flowers regularly produce certain mutations with characteristics which do not become fixed. He says:

> Such deviations are usually called sports. But they occur yearly and regularly and may be observed when the cultures are large enough. Such a variety I shall call "ever-sporting."
>
> The striped larkspur is one of the oldest garden varieties. It has kept its capacity of sporting through centuries, and therefore may in some sense be said to be quite stable. Its changes are limited to a rather narrow circle and this circle is as constant as the peculiarities of any other constant species or variety. But within this circle it is always changing from small stripes to broad streaks and from them to pure colors. * * * Combining the stability and the qualities of sports in one word, we may evidently best express it by the new term of ever-sporting variety.[1]

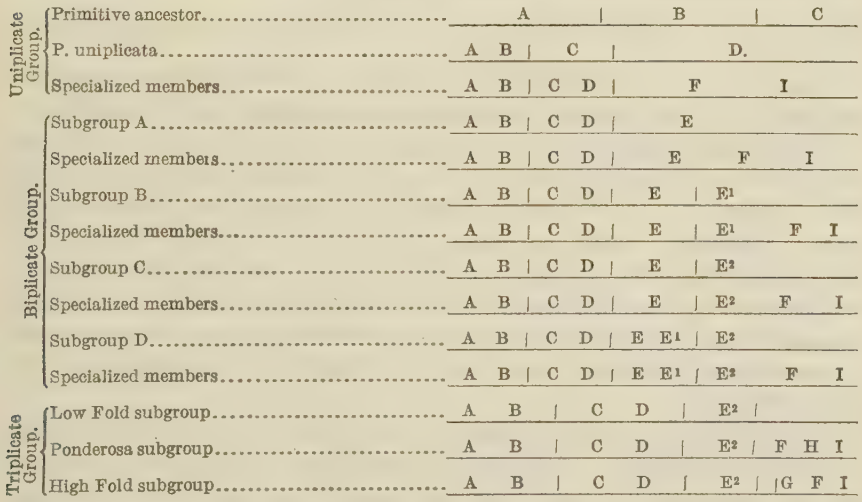
[1] Species and Varieties. Their Origin by Mutation, p. 311.

It seems to the writer that the species of *Platystrophia* represent the "ever-sporting varieties" of De Vries, and the different mutations are marked by variation in the plication pattern. The propagation of these mutations is most prominent in the Low Fold and *Ponderosa* subgroups and rare in the High Fold subgroup.

This development is so pronounced in *Platystrophia elegantula*, new species, that it has become of specific value. *Platystrophia narrowensis* also shows a prolific development of these individuals.

ORTHOGENESIS.

In order to simplify the discussion of the life history it is thought advisable to construct first a diagram as a guide to the discussion which will follow. The purpose of the diagram is to illustrate the common characters of the various groups and subgroups into which the genus can be subdivided and the common order of appearance of these characters. The line represents the ontogeny and it is subdivided into the ontogenetic stages which are indicated by letters. The early onto stages are so condensed as to make it impossible to measure with accuracy their relative duration, but an effort is made to indicate where a developmental stage is noticeably shorter in one group than in another.


Uniplicate Group.
Primitive ancestor A | B | C
P. uniplicata A B | C | D.
Specialized members A B | C D | F I
Biplicate Group.
Subgroup A A B | C D | E
Specialized members A B | C D | E F I
Subgroup B A B | C D | E | E¹
Specialized members A B | C D | E | E¹ F I
Subgroup C A B | C D | E | E²
Specialized members A B | C D | E | E² F I
Subgroup D A B | C D | E E¹ | E²
Specialized members A B | C D | E E¹ | E² F I
Triplicate Group.
Low Fold subgroup A B | C D | E² |
Ponderosa subgroup A B | C D | E² | F H I
High Fold subgroup A B | C D | E² | G F I

MORPHIC STAGES.

A. Smooth protegulum stage.
B. Ribbed stage.
C. True ventral sinus and brachial fold developed.
D. Plications added on lateral slopes.
E. Plication in sinus bifurcates and plication intercalated in a median position on fold.
E¹. Plication intercalated in a median position in the sinus and median plication on the fold bifurcates.
E². Plication implanted on each slope of sinus and primary plication of fold bifurcates.
F. Increase in size.
G. Elevation of fold.
H. Excessive increase in size.
I. Specialized and individual characters.

An examination of the diagram shows that all *Platystrophias* pass through stages A, B, C, and it is inferred that these stages represent the entire life history of a primitive ancestor which lived in late Cambrian or early Ordovician time. The uniplicate group adds stage D, and the more specialized species of the group add stages F and I. Subgroup A recapitulates the development of the unspecialized members of the uniplicate group and adds stage E, and the more specialized species add stages F and I. Subgroup B recapitulates the ontogeny of the unspecialized members of subgroup A and adds stage E^1 and the more specialized species add F and I. Subgroup C recapitulates the ontogeny of the unspecialized members of subgroup A, and adds stage E^2 and the more specialized members add F and I. Subgroup D recapitulates the ontogeny of the unspeccialized members of subgroup B and adds stage E^2 and the specialized species add stages F and I.

The low-fold subgroup recapitulates the ontogeny of the unspecialized members of the uniplicate group and adds stage E^2 and the more specialized species adds stages F and I. The *Ponderosa* subgroup recapitulates the ontogeny of the low-fold subgroup and adds stage H, and the high-fold subgroup recapitulates the ontogeny of the low-fold subgroup and adds stage E.

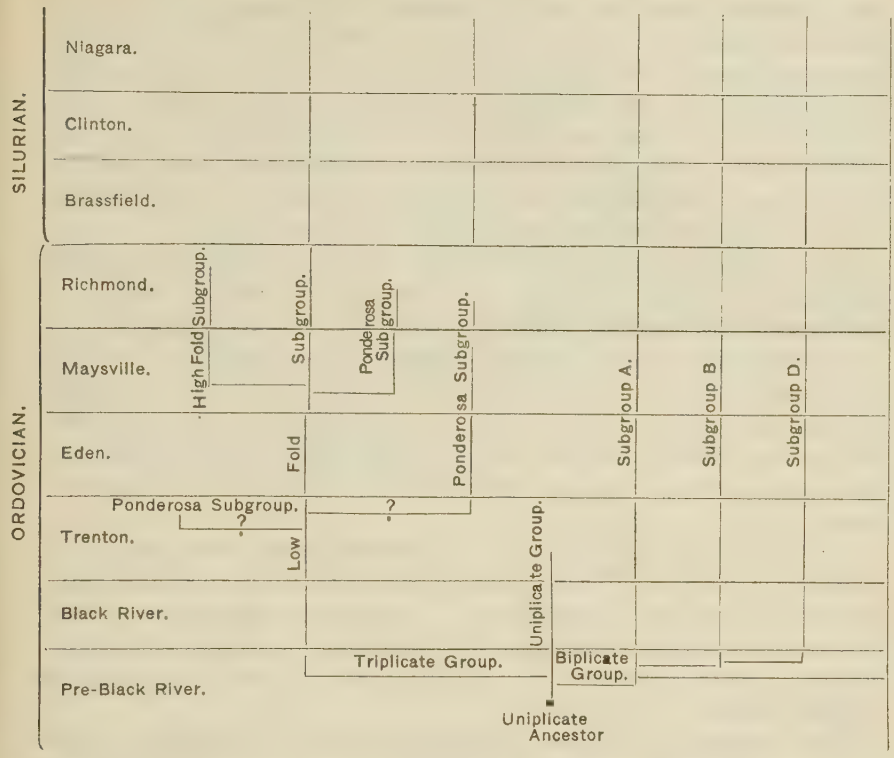
CORRELATION OF THE PHYLOGENY AND STRATIGRAPHIC SUCCESSION.

This progressive development is in harmony with the stratigraphic succession of the species representing the groups and subgroups.

According to our present knowledge species of this genus appeared in North America and Europe in early Middle Ordovician time. The earliest North American form is found in the Black River group (Decorah Shale) 4½ miles north of Fennemore, Tennessee. This form has been referred to *Platystrophia extensa*, new species, and belongs to the triplicate group. As the long hinge and broad lateral slopes bearing numerous plications indicate a certain degree of specialization it is evident that the genus was in existence prior to this time.

Hall and Clarke [1] have reported a form from the Chazy. Winchell and Schuchert say,[2] "This widely distributed and protean species has its beginning in North America in the Chazy group and is found in all geological horizons upward and into the Niagara formation." Schuchert [3] and Ruedemann [4] have also reported occurrence of species in the Chazy.

[1] Paleontology of New York, vol. 8, pt. 1, Brachiopoda, 1892, p. 202.
[2] Geol. of Minnesota, vol. 3, pt. 1, Paleontology, 1892, p. 456.
[3] Synopsis of American Fossil Brachiopoda, 1897, p. 309.
[4] Bull. N. Y. State Museum, No. 49, 1891, 1902, p. 25.



In the extensive collections belonging to the United States National Museum no members of this genus were found below the Black River Group. Professor Cumings investigated this point and reached the same conclusions. He says: [1]

I am unable to find any original references in the literature to its occurrence in the rocks of this age (Chazy). Messrs. Ami, Whiteaves, and W. Billings of Ottawa, Canada, inform me that the Museum of the Canadian Survey contains no Chazy specimens; and that they are not aware that the species has ever been found in that series. Mr. Billings suggests that it may have been found in rocks formerly held as Chazy, but now known to be of later age. Mr. McBride, of Montreal, writes that there are no Chazy specimens in the Museums at Montreal and that he does not know of the occurrence of *Platystrophia* in the Chazy. Mr. Seely, who is familiar with the Chazy, writes to the same effect. It is very probable, therefore, that the form is not known to occur below the Trenton in this country.

While our knowledge does not substantiate the occurrence of this genus below the Decorah Shale, the degree of variation which it has reached by that time leads the writer to expect that earlier species will come to light with more extended investigation.

The Black River and early Trenton species show but little variation in general physiognomy. The shells are equiconvex and have

[1] Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 5.

low spreading folds and shallow sinuses. The genus had expressed its invariability in Cambrian or early Ordovician time by differentiation of the plication pattern of the fold and sinus. This differentiation was at that time only of specific value. These species, however, became the source of lines of development which persisted until the extinction of the race. Thus, while near the origin of the genus differentiation was not pronounced, the variation which achieved expression was of high taxonomic value.

The uniplicate group is confined to the Lower Trenton of North America and seems to occupy that horizon in Europe, where it is associated with members of the biplicate and triplicate groups.

In North America the biplicate group is not found in the Ordovician above the Lower Trenton except in the Uppermost Richmond of Anticosti Island. Its recurrence in North American early Silurian points to its existence during Middle and Upper Trenton and Cincinnatian time in an area which was cut off from North American seas.

The writer had access to about 200 specimens from the Baltic province of Europe. These range in age from Lower Middle Ordovician (Kuckers) into the Silurian. A uniplicate species was found to occur in the Jewe, and one specimen was found which occurred in the Upper Ordovician (F^1). All the other species belonged to the biplicate group.

The inaccessibility of the literature made it impossible for the writer to determine the limits of the European species and the group to which they belong. The figures and descriptions by Davidson and other authors help but little. Davidson's figures 15*a*, 17, 18, 19[1] represent specimens of the biplicate type from the Caradoc. The Wenlock species (figs. 11, 11*a*) are also of the biplicate type and seem to be related to *Platystrophia regularis* Shaler. The abundance of this group throughout European Ordovician and its limitation to the Lower Trenton and early Silurian of North America suggest an invasion from that area which was followed by extinction of the invading forms.

The Trenton members of the triplicate group belong to the low-fold subgroup which is most closely related to the ancestral stock. Members of this subgroup persisted into the Maysville, but by the end of that time they became rare. A reincursion in Richmond time brought in several species belonging to the low-fold subgroup which are scarcely distinguishable from Trenton forms. Extreme specialization and extinction was reached in late Cincinnatian and early Silurian time.

The high-fold subgroup originated in early Maysville. It became the predominant type in Middle Maysville to Middle Richmond

[1] British Fossil Brachiopoda, vol. 1, pl. 28.

time and marks the acme of specialization which was reached by the genus.

The *Ponderosa* subgroup which is conspicuous in Maysville and Lower Richmond time represents members of the genus which ex pended their energy in acquiring large size and then became prematurely old while the race as a whole was progressive.

The writer was unable to determine the relative abundance and stratigraphic succession of European members of the genus.

Davidson's figures, 12, 13, and 25[1] are distinctly of the triplicate type, and seem to be related to *Platystrophia colbeinsis* Foerste. Figure 14[1] evidently marks a retrograde form of this species as is indicated by the one plication in the sinus.

[1] British Fossil Brachiopoda, vol. 1, pl. 38.

Stratigraphic distribution of groups, subgroups, and species of Platystrophia in North America.

| Groups. | Subgroups. | Species. | Ordovician. | | |

	Triplicate.	Low fold.	Penderosa.	High fold.
Platystrophia rhynchonelliformis, new species	×			
Platystrophia colbiensis Foerste				
Platystrophia colbiensis mutata Foerste	×	×		
Platystrophia precursor Foerste		×		
Platystrophia precursor latiformis, new variety		×		
Platystrophia precursor angustata, new variety				
Platystrophia juvenis, new species				
Platystrophia praeplicata Cumings				
Platystrophia striposa, new species				
Platystrophia nitida, new species				
Platystrophia morrowensis (James)				
Platystrophia corrugatilensis, new species				
Platystrophia sublaticosta, new species				
Platystrophia acuminata (James)				
Platystrophia foerstei, new species				
Platystrophia foerstei ampla, new variety				
Platystrophia attenuata, new species				
Platystrophia clarksvillensis Foerste				
Platystrophia cumingsi, new species				
Platystrophia annieana Foerste				
Platystrophia moritura Cumings				
Platystrophia acutilirata (Conrad)				
Platystrophia acutilirata prolongata Foerste				
Platystrophia senex Cumings				
Platystrophia ekhoraensis, new species				
Platystrophia prepondorosa, new species				
Platystrophia ponderosa Foerste				
Platystrophia ponderosa auburnensis Foerste				
Platystrophia ponderosa arnheimensis, new variety				
Platystrophia ponderosa, varieties undescribed				
Platystrophia? ervaviensis, new species				
Platystrophia profundosulcata (Meek)				
Platystrophia profundosulcata hopensis Foerste				
Platystrophia crassa (James)				
Platystrophia crassa? variety undescribed				

Stratigraphic distribution of groups, subgroups, and species of Platystrophia in North America—Continued.

Groups.	Subgroups.	Species.	Pre Decorah.	Ordovician.																												Silurian.		
				Black River.		Trenton.												Cincinnatian.																		
																		Eden.		Maysville.					Richmond.										
				Decorah.	Kimmeswick.	L. Trenton Undifferentiated.	Curdsville.	Prosser.	Hermitage.	Wilmore.	M. Trenton Undifferentiated.	Bigby.	Flanagan.	Greendale.	Catheys.	Cynthiana.	Untra.	Frankfort.	Mount Hope.	Fairmount.	Bellevue.	Corryville.	Mount Auburn.	Arnheim.	Waynesville.	Fernvale.	Liberty.	Saluda-Whitewater.	Elkhorn.	Gamachian.	Brassfield.	Clinton.	Niagara.			
Triplicate.	High fold.	*Platystrophia laticosta* (Meek)																		×	××	××												
		Platystrophia unicostata Cumings																			××	××												
		Platystrophia unicostata crassiformis, new variety																			×	×												
		Platystrophia cypha (James)																						×										
		Platystrophia cypha tumida new variety																						×										
		Platystrophia cypha arcta, new variety																						×										
		Platystrophia cypha bellatula, new variety																						×	×									
		Platystrophia wallowayi Foerste																						×										

DESCRIPTION OF SPECIES.

1. UNIPLICATE GROUP.

PLATYSTROPHIA UNIPLICATA, new species.

Plate 42, figs. 1, 2.

Two specimens of a uniplicate *Platystrophia* were found in the Trenton of Lake Champlain. They are small and have low rounded folds on which are two plications which appear to originate in a point at the beak and extend to the frontal margin with a deep widening furrow between them. The shallow sinus is occupied by one median plication which originates at the beak and extends to the frontal margin. The lateral slopes are occupied by nine plications.

Measurements.—8.2 mm. along the hinge line, 12 mm. wide across the middle, 9 mm. high, 7 mm. thick, 5.5 mm. sinal width, 3 mm. sinal depth, 1 mm. fold depth.

Occurrence.—Trenton limestone near Lake Champlain, New York.

Holotype.—Cat. No. 66109, U.S.N.M.

2. BIPLICATE GROUP.

a. SUBGROUP A.

PLATYSTROPHIA PRECEDENS, new species.

Plate 42, figs. 7, 8.

A form occurring in relatively small numbers seems to represent an intermediate development between the uniplicate group and subgroup B of the biplicate group.

It has three plications on the fold, two of which are primary and appear to originate in a point at the beak, and one of which is a secondary plication intercalated in a median position; while in the sinus there are two secondary plications which have originated by the bifurcation of the primary plication at the beak.

It differs from *Platystrophia trentonensis*, new species, in that the median plication on the fold has not bifurcated, and in the absence of the median intercalated plication in the sinus.

Occurrence.—Trenton limestone, Lake Champlain, New York. Curdsville limestone of the Trenton group, Mercer County, Ky.

Cotypes.—Cat. Nos. 66111, 66112, U.S.N.M.

PLATYSTROPHIA REGULARIS Shaler.

Plate 42, figs. 21, 22.

Platystrophia regularis SHALER, Bull. Mus. Comp. Zool., vol. 4, 1865, p. 67.

Shaler's original description is as follows:

Outline much the same as that of other members of the group. Socket valve one-fourth more projecting than toothed valve; hinge line a little less than diameter of shell, three-fifths greater than distance from beak to border. That portion of the margin

occupied by the fold and sinus is reentering, the depth of the incurvation being about equal to the elevation of the umbo above the hinge line. The depressions of the sinus is occupied by only two plications and the ridge by three similar folds. On either side are from eight to nine plications. The numbers seem invariable.

The muscular area of the toothed valve is long and narrow, length being three or four times the width, extending nearly to the center of the valve—a feature in which this species differs from its representatives.

Occurrence.—Gamachen (Ellis Bay) and Anticostian (Gun River) Junction Cliff, etc., Anticosta.

Plesiotype.—No. 66108, U.S.N.M.

PLATYSTROPHIA DAYTONENSIS (Foerste).

Plate 42, fig. 24.

Orthis biforata var. *lynx forma daytonensis* FOERSTE, Bull. Sci. Lab., Denison Univ., 1, 1885, p. 81, pl. 13, figs. 1–8.

Orthis (*Platystrophia*) *biforata* (part) FOERSTE, Geol. Surv. Ohio, vol. 7, 1895, p. 579, pl. 25, fig. 8.

Platystrophia daytonensis SAVAGE, Bull. Geol. Surv. Illinois, vol. 23, 1913, p. 76, pl. 4, fig. 8.

The shell is small, wider than long with a subquadrate outline. The hinge line about equals the width across the middle. The fold bears three plications. Two originate in a point at the beak, the third is intercalated in a median position when the shell is about 1 mm. long. There are two plications in the sinus. As the posterior portion of the pedicle valve of the one specimen was broken away nothing definite can be said as to their origin, but it is inferred from other specimens which have a like plication pattern on the fold, that the two originate by the bifurcation of a primary plication at the beak. The lateral slopes are occupied by nine roundish plications which are separated by their own width.

Measurements.—18.5 mm. along the hinge line, 18.5 mm. wide across the middle, 14.2 mm. high, 13 mm. thick, 8 mm. sinal width, 6.7 mm. sinal depth, 2.5 fold depth.

Occurrence.—Brassfield formation, Dayton, Ohio; Hanover, Indiana; Cumberland Gap, Tennessee; Collinsville, Alabama; Nelson County, Kentucky. Edgewood formation: Edgewood and Louisiana, Missouri; Theber, Illinois.

Plesiotypes.—Cat. No. 66114, U.S.N.M.

PLATYSTROPHIA DAYTONENSIS LAURELENSIS, new variety.

Plate 42, figs. 42, 43.

This variety is distinguished from the Brassfield specimens by its smaller size and narrower form.

Measurements.—13 mm. along the hinge line, 14 mm. wide across the middle, 12 mm. high, 11 mm. thick (estimated), 18 mm. sinal width, 5 mm. sinal depth, 2 mm. fold height.

Occurrence.—Niagara group: Laurel limestone, St. Paul and Heatons Branch, East of St. Omar, Indiana.

Cotypes.—Cat. No. 66116, U.S.N.M.

b. SUBGROUP B—TRENTON SPECIES.

PLATYSTROPHIA TRENTONENSIS, new species.

Plate 42, figs. 3–6.

Platystrophia biforata GRABAU and SHIMER, North American Index Fossils, vol. 1, 1903, p. 258.—CUMINGS (part), Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 41.

In the Trenton limestone occurs a long hinged form which has the plication pattern of the Biplicate group. The hinge line is equal to or greater than the width across the middle. The fold is scarcely elevated above the convexity of the brachial valve, and it bears four plications of equal strength. The sinus of the pedicle valve is moderately deep and bears three plications of equal strength. There are twelve to fifteen plications on the lateral slopes.

This species has some resemblance to *Platystrophia amoena longicardinalis*, new variety, but the latter species belongs to the triplicate group.

Measurements.—16.7 mm. along the hinge line, 16 mm. across the middle, 12.3 mm. high, 11 mm. thick, 7.4 mm. sinal width, 4.7 mm. sinal depth, 0.7 mm. fold height.

Occurrence.—Trenton group. Prosser limestone at Fountain and Montorville, Minnesota, and at Decorah, Iowa. Curdsville limestone at Troy, Kentucky. Trenton limestone at St. Joseph Island, Lake Huron.

Cotypes.—Cat. Nos. 39052, 66097, U.S.N.M.

PLATYSTROPHIA TRENTONENSIS CHAMPLAINENSIS, new variety.

Plate 42, figs. 9–11.

Platystrophia biforata CUMINGS (part), Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 41.

In the Trenton limestone of Lake Champlain is a small form which resembles *Platystrophia elegantula*, new species in the shape of the shell but the forms are easily distinguished by their plication patterns.

This variety differs from typical specimens of the species in possessing a much shorter hinge-line and in a tendency toward obsolescence of plications next to the cardinal angles.

Occurrence.—Trenton limestone, near Lake Champlain, New York.

Holotype.—Cat. No. 66099, U.S.N.M.

PLATYSTROPHIA TRENTONENSIS PERPLANA, new variety.

Plate 42, figs. 12–14.

Platystrophia biforata WELLER, Pal. New Jersey, vol. 3, 1903, p. 153, pl. 9, figs. 25–28.

This variety is distinguished from other members of the species by its greater width and height and thinner form. The fold is

broad and low and the sinus broad and shallow. Nine plications occupy the lateral slopes. The hinge line generally equals the width across the middle, but it may be somewhat less than the width.

Measurements.—18 mm. along the hinge line, 18.5 mm. wide across the middle, 12.5 mm. high, 8.5 mm. thick, 10 mm. sinal width, 2.5 mm. fold height.

Occurrence.—Trenton group. Curdsville limestone: Mercer County, Shyrock's Ferry and Bergen, Kentucky; and Crossville Quadrangle, Tennessee. Prosser limestone at Fountain, Minnesota: Jacksonburg limestone, New Jersey.

Cotypes.—Cat. Nos. 66093, 66095, U.S.N.M.

c. SUBGROUP C.

PLATYSTROPHIA BRACHYNOTA (Hall).

Plate 42, figs. 25–28.

Delthyris brachynota HALL, Geol. New York, Rept. 4th Dist., 1843, p. 70. fig. 6.
Orthis biforata NETTELROTH, Kentucky, Foss. Shells, 1889, p. 35, pl. 29, figs. 18–22.
Spirifer biforatus var. *lynx* HALL, Pal. New York, vol. 2, 1852, pl. 22, fig. 1.
Orthis lynx CHAPMAN, Canadian Journ., new ser., vol. 8, 1863, p. 199, fig. 185.

This species is about the size of *Platystrophia daytonensis*, but it always has a shorter hinge line and a greater number of plications on the fold and sinus. After the one plication in the sinus has bifurcated a lateral plication is added on each of the sinal slopes, while on the fold, the intercalation of the median plication is followed by the bifurcation of the primary plications. Seven and eight plications occupy the lateral slopes.

Measurements.—17.3 mm. along the hinge; 20.4 mm. wide across the middle; 14.5 mm. high; 11 mm. sinal width; 6 mm. sinal depth; 3.5 mm. fold height.

Occurrence.—Clinton group of New York. Brassfield limestone, Nelson County, Kentucky. Niagara Group. Reynolds Basin, Niagara County, New York. Louisville limestone, Louisville, Kentucky.

Plesiotypes.—Cat. Nos. 39046, 51348, U.S.N.M.

PLATYSTROPHIA REVERSATA (Foerste).

Plate 42, fig. 23.

Platystrophia biforata var. *lynx* forma *reversata* FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 1, 1885, p. 81, pl. 13, fig. 7.
Orthis (*Platystrophia*) *biforata* (part) FOERSTE, Pal. Ohio, vol. 7, 1895, p. 579, pl. 25, fig. 8.

This was described by Foerste as follows:

Shell attaining a fair size, the dorsal valve a little larger; shell wider than long, with a subquadrate outline; no very gibbous forms have as yet been found; hinge line less than the greatest breadth of the valves; cardinal extremities obtusely angular; lateral margins rather sinuous near the hinge-line, rounding to the front, where it is

somewhat sinuously rounded at the junction of the mesial sinus and fold. Beaks nearly equal, incurved and approximate, sometimes almost touching; cardinal areas nearly equal.

Dorsal valve more convex than the ventral, its greatest convexity being near the middle. Mesial fold rather rounded, arising near the beak, becoming more prominent as it extends forward, with rounded sides; beak projecting beyond the hinge margin, strongly incurved; cardinal area directed backward, somewhat incurved; foramen broad, triangular and not closed by the cardinal process.

Ventral valve of a mesial sinus, beginning near the beak, extending forward, terminating in a rounded projection which continues the curvature of the shell and thus produces a sinuous outline for the front edge of the shell. Surface of the valve rounded into the moderately concave sinus. Beak less strongly incurved than that of the dorsal valve. Cardinal area incurved and directed backward, less, however, than that of the other valve. Foramen triangular, wider than high; hinge teeth moderately prominent and trigonal; muscular cavity oblong, little more than one third the length of the shell, lateral margins parallel, well defined by the dental ridges. On either side of this cavity are a number of short striae, which are arranged in longitudinal lines following about the direction of the plications.

Surface of each valve with rounded, radiating plications, from 24 to 36 in number, of which 4 to 6 occupy the mesial sinus, and 5 to 7 (in one specimen 10 or 11) the mesial fold. In the sinus two plications begin at the beak, two additional ones are immediately added, and later one or two more at one-third or one-half the length of the shell from the beak. On the mesial fold three plications originate at the beak, to which two more are added at one-fourth the length of the shell from the beak; later two more appear and in one specimen in hand 10 or 11 plications are more or less distinctly shown. The plications in the sinus and on the fold branch in all specimens as described above; the lateral ones, 10 to 15 in number, are almost always simple. Lines of growth not shown in the specimens found. Well preserved specimens under the microscope show numerous minute granules, arranged in regular rows across the plications.

Occurrence—Brassfield limestone; Dayton, Ohio.
Plesiotype.—Cat. No. 48626 U.S.N.M.

d. SUBGROUP D.

PLATYSTROPHIA HERMITAGENSIS, new species.

Plate 42, figs. 15–19.

This represents a species, the types of which were collected from the Hermitage limestone of Auburn, Tennessee. It is a thin, long-hinged form with subequally convex valves. The species resembles *Platystrophia extensa*, new species, in general physiognomy, but the latter belongs to the Triplicate Group.

In the nepionic stage there is one plication in the sinus and two on the fold which appear to originate in a point at the beak. The neanic stage is initiated by the bifurcation of the plication in the sinus and on the fold this development is marked by the intercalation of a median secondary plication. After a slight interval of growth a plication is intercalated in a median position in the sinus, and a little later a plication is implanted on each of the sinal slopes, while on the fold first the median plications and then the primary plications bifurcate.

Some specimens do not show a further development but the greater number show that the median plication in the sinus has bifurcated and a seventh plication is intercalated on the fold in a median position.

There are 9 to 13 somewhat round plications on the lateral slopes. The slopes of the pedicle valve are almost flat or slightly concave; those of the brachial valve are slightly convex. The fold is low and broad and the sinus is shallow. The characteristic granular markings of the surface are unusually distinct.

Measurements.—27.4 mm. along the hinge, 24 mm. wide across the middle, 14.4 mm. high, 10 mm. thick, 9 mm. sinal width, 4.2 mm sinal depth, 1.2 mm. fold height.

Occurrence.—Trenton group. Hermitage limestone; Payton's Creek, 6 miles northwest of Carthage, and Auburn, Tennessee.

Cotypes.—Cat. Nos. 66100, 66101, U.S.N.M.

3. TRIPLICATE GROUP.

a. LOW FOLD SUBGROUP.

PLATYSTROPHIA EXTENSA, new species.

Plate 42, figs. 39–41.

Associated with *Platsystrophia hermitagensis* is a species with the same general physiognomy. Its distinguishing characteristic is the plication pattern of the fold and sinus which places it with the *Triplicate group.*

The hinge line varies from nearly as great to greater than the width of the shell across the middle. The valves are subequally convex. The slopes of the brachial valve are flattish, with a tendency to become concave; those of the pedicle valve are convex. There are 9 to 13 round plications on the lateral slopes, which are separated by furrows of their own width.

Two specimens were found in the Decorah shale near Fennemore, Tennessee, which are referred to this species. However, they have proportionally longer hinge lines and more ventricose forms than the Trenton specimens.

A specimen measures 21 mm. along the hinge, 20.5 mm. wide across the middle, 12 mm. high, 8.8 mm. thick, 7.5 mm. sinal width, 2.7 mm. sinal depth, 1 mm. fold height.

Occurrence.—Trenton group: Hermitage limestone at Hartsville and Auburn, Tennessee. Black River group: Decorah shale 4½ miles north of Fennimore, Wisconsin.

Cotypes.—Cat. Nos. 66102, 66103, U.S.N.M.

PLATYSTROPHIA ELEGANTULA, new species.

Plate 43, figs. 44–47.

The types of this species were found in the Bigby limestone of the Trenton group at Frankfort, Kentucky, and vicinity. It is common

at various localities in Kentucky and Tennessee and was found to be present in New York.

The species is characterized by its small size and subglobose form. The hinge line is always less than the greatest width. The slopes are convex and are covered by nine fine rounded plications which are separated by furrows of their own width. The fold is low and the sinus shallow. Both the fold and sinus become progressively wider toward the front.

Near the beak there are three plications in the sinus and four on the fold. When the shell has reached a length of about 6 mm., plications are added by implantation in the sinus and bifurcation on the fold, sometimes between the original plications and sometimes on the slopes.

This species differs from *Platystrophia amoena*, new species, in its shorter hinge and in that there are, as a rule, more than three plications in the sinus and four on the fold. The latter species shows a tendency toward the loss of plications rather than the addition of them.

All species of *Platystrophia* show a tendency to produce mutations which develop many plications on the fold and sinus. This species seems to have developed from one of these mutations.

Occurrence.—Trenton group: Bigby limestone at Frankfort, Kentucky, and vicinity, and Hartsville, Tennessee. Trenton group at Ellisburg, New York.

Cotypes.—Cat. No. 24244, U.S.N.M.

PLATYSTROPHIA ELEGANTULA TRIPLICATA, new variety.

Plate 43, fig. 48.

Platystrophia lynx CUMINGS, Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 41.

This variety has all the characteristics of the types except that there are only three plications in the sinus and four on the fold. It resembles the shorter hinged mutations of *Platystrophia amoena*, new species, and may prove to be a variety of that species.

Occurrence.—Trenton group: Bigby limestone, Duckers and Frankfort, Kentucky; Nashville, Tennessee. Trenton limestone, Ellisburg and Trenton Falls, New York, and in Baffin Land.

Holotype.—Cat. No. 66126, U.S.N.M.

PLATYSTROPHIA ELEGANTULA AMPLISULCATA, new variety.

Plate 43, fig. 49.

This represents a variety of *Platystrophia elegantula* with a decidedly shorter hinge line than typical specimens and a broader fold and sinus which bear more numerous plications.

Measurements.—11.2 mm. along the hinge, 18.5 mm. wide across the middle, 13.5 mm. high, 12.3 mm. thick, 10 mm. sinal width, and 6.8 mm. sinal depth.

Occurrence.—Trenton group: Bigby limestone, Frankfort, Kentucky. Trenton limestone, Ellisburg, New York.

Cotypes.—Cat. No. 66124, U.S.N.M.

PLATYSTROPHIA AMOENA, new species.

Plate 43, figs. 1–8.

Platystrophia lynx CUMINGS, Amer. Journ. Sci., ser. 4, vol. 15, 1903, pp. 20, 22, 24, figs. 8, 10.

Orthis biforata HALL and CLARKE, Pal. New York, vol. 8, pt. 1, 1892, pl. 5B, fig. 10.

This is a thin transverse species with subequally convex valves. The hinge line is as long or nearly as long as the width across the middle. The fold is low and spreading and the sinus is shallow. The fold is occupied by four and the sinus by three plications. There are nine plications on the lateral slopes.

This species resembles *Platystrophia elegantula*, new species, but it lacks the curved plications on the lateral slopes, and it has a longer hinge line than that species. A much thicker variety is found at various localities associated with typical specimens. The thickness may become as great as or greater than the height. Shells of this type are abundant at Trenton Falls, New York, and for these the name *Platystrophia amoena robusta* (pl. 43, figs. 14–17, Cat. No. 66091, U.S.N.M.) is suggested.

Measurements.—13 mm. along the hinge line, 14 mm. wide across the middle, 10 mm. high, 6.3 mm. thick, 5.5 mm. sinal width, 2 mm. sinal depth, 0.7 mm. fold depth.

Occurrence.—Trenton group. Bigby limestone, Versailles, Frankfort, Lexington, Benson Station, etc., Kentucky. Trenton limestone of Trenton Falls, New York. Prosser limestone of Cannon Falls and Warsaw, Minnesota. Cynthiana formation, Tennessee.

Cotypes.—Cat. Nos. 39057, 48612, 48615, 66072, 66076, 66091, U.S.N.M.

PLATYSTROPHIA AMOENA LONGICARDINALIS, new variety.

Plate 43, figs. 9–13.

The distinguishing characteristic of this variety is the great width in reference to the height. The hinge line always forms the greatest width and the cardinal extremes are acuminate and thin. The thinness is due to the compression of the slopes of both valves.

Owing to the long hinge line this variety resembles *Platystrophia trentonensis*, new species, but the plications of the latter species place it with the biplicate group of shells, while this species belongs to the triplicate group.

Measurements.—15 mm. along the hinge, 12 mm. wide across the middle, 8.2 mm. high, 7 mm. thick, 5.5 mm. sinal width, 3.8 mm. sinal depth, 1 mm. fold height.

Occurrence.—Trenton group: Prosser limestone, Oshkosh, Wisconsin; Warsaw, Fountain, and Cannon Falls, Minnesota; Curdsville limestone: Mercer County, Kentucky. Trenton limestone: Trenton Falls, New York.

Cotypes.—Cat. Nos. 24805, 66083, U.S.N.M.

PLATYSTROPHIA GLOBOSA, new species.

Plate 43, figs. 18–22.

This is a globose species with the convexity nearly equaling the width and height. The hinge line about equals the width across the middle, but it may be a little less or a little greater. The lateral slopes are abrupt. A slight compression of the slopes of the pedicle valve produces a concavity next to the cardinal angles; the fold is low and somewhat flaring toward the front; the sinus is broad and moderately deep, the depth being due to a slight elevation of the inner edges of the lateral slopes of the pedicle valve. There are three subequal plications in the sinus, four on the fold, and nine on each of the lateral slopes.

This species has the general physiognomy of *Platystrophia crassa*, but it has a low, spreading fold, is smaller, and has invariably eight or nine plications on the lateral slopes. The plications of the fold and sinus are subequal while in *Platystrophia crassa* the lateral plications of the fold and sinus are weak or have disappeared.

Measurements.—18 mm. along the hinge line, 17.7 mm. across the middle, 15.8 mm. high, 15.2 mm. thick, 11.5 mm. sinal width, 5.7 mm. sinal depth, 2 mm. fold height.

Occurrence.—Trenton group: Bigby limestone: Nashville, Tennessee. Trenton limestone: Ellisburg, New York.

Cotypes.—Cat. Nos. 66119, 66120, U.S.N.M.

PLATYSTROPHIA RHYNCHONELLIFORMIS, new species.

Plate 42, figs. 36–38.

This represents a small, short hinged, globose species with a moderately elevated and compressed fold. There are three plications in the sinus and four on the fold which have the pattern of the *Triplicate Group*. Six and seven plications occupy the lateral slopes. The slopes of the brachial valve are strongly convex in the umbonal region. They descend rapidly to the cardinal and lateral and less rapidly toward the frontal margin. The slopes of the pedicle valve are convex next to the sinus and become flat or concave next to the cardinal extremes.

Measurements.—7.2 mm. along the hinge line, 13 mm. wide just below the middle, 10.1 mm. high, 9.4 mm. thick, 7.2 mm. sinal width, 4.5 mm. sinal depth, 2.8 mm. fold depth.

Occurrence.—Trenton limestone at Ellisburg, New York.

Cotypes.—Cat. No. 66106, U.S.N.M.

PLATYSTROPHIA COLBIENSIS Foerste.

Plate 44, figs. 8–11.

Platystrophia colbiensis FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 55, pl. 4, figs. 2A–B.

Platystrophia of colbiensis FOERSTE, Journ. Cincinnati Soc. Nat. Hist., vol. 21, 1914, p. 131.

In the Upper Trenton of Kentucky and Tennessee occurs the species which Doctor Foerste has described as *Platystrophia colbiensis*. The fold is slightly elevated and slightly compressed; the sinus is shallow. Four subequal plications occupy the fold; they have originated by the bifurcation of the two primary plications at the beak. There are three subequal plications in the sinus; one is primary and occupies a median position; two are lateral, secondary plications which are implanted on the slopes of the sinus at about 1.5 mm. from the beak. There are 9 to 11 plications on the lateral slopes. Young specimens have subequally convex valves, but the brachial valve of older specimens is quite ventricose.

This species is larger than *Platystrophia amoena* new species and the fold is slightly compressed, while the fold of that species becomes progressively wider as it approaches the frontal margin.

Measurements.—20.6 mm. along the hinge line, 21.6 mm. wide across the middle, 15.3 mm. high, 14.4 mm. thick, 9 mm. sinal width, 6.5 mm. sinal depth, 2 mm. fold depth.

Occurrence.—Trenton group: Cynthiana limestone: Between Colby and Winchester, Paris, Lexington, Frankfort, etc., Kentucky. Catheys formation: Edgefield Junction and Nashville, Tennessee.

Plesiotypes.—Cat. Nos. 34231, 48614, U.S.N.M.

PLATYSTROPHIA COLBIENSIS-MUTATA Foerste.

Plate 44, fig. 12.

Platystrophia colbiensis mutata FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 56, pl. 4, figs. 3*a–b*.

Among the specimens representing *Platystrophia colbiensis* there are thinner and somewhat higher and broader shells with more than four plications on the fold and more than three in the sinus. The number varies generally from five to six on the fold and four to five in the sinus. The increase is effected by the bifurcation of the lateral plications of the fold and by implantation on the slopes of the sinus. One specimen has eight plications on the fold and seven plications in the sinus. In this case both the median and lateral plications of the fold have bifurcated and tertiary plications have been implanted on the slopes of the sinus and between the primary and secondary plications.

Occurrence.—Trenton group: Greendale beds: Pleasant Valley and Winchester, Kentucky. Catheys limestone: Nashville, Mount Pleasant, and near Gallatin, Tennessee.

Plesiotype.—Cat. No. 65914, U.S.N.M.

PLATYSTROPHIA PRECURSOR Foerste.

Plate 44, figs. 1–4, 17–20.

Platystrophia colbiensis precursor FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 57, pl. 41, fig. 1.

This abundant Upper Trenton fossil is represented by larger specimens than are usually found at this horizon. It is a transverse form with a low fold and shallow sinus bearing subequal plications. The lateral slopes are occupied by nine plications. The slopes of the brachial valve are convex in the two-thirds next to the fold, and slightly concave in the one-third next to the cardinal extremes. The slopes of the pedicle valve are convex next to the sinus and become concave next to the cardinal extremes.

Specimens having the same general aspect occur at various horizons in the Maysville and Richmond. *Platystrophia sublaticosta*, new species, of the Bellevue and Corryville beds, differs from it in having seven plications on the lateral slopes. *Platystrophia laticosta* and *Platystrophia cypha* are thicker and more compressed; they also have dwarfed lateral plications on the lateral slopes of the fold and sinus, while in this species the plications are subequal. *Platystrophia precursor* is less ventricose and has a greater height than *Platystrophia clarksvillensis* of the Waynesville formation. It has many characteristics in common with *Platystrophia annieana*, but the latter has a deeper sinus.

By selection it is possible to differentiate from among numerous specimens of *Platystrophia precursor* a small number of individuals which have a somewhat higher fold and deeper sinus. For these specimens the varietal name, *profunda* (pl. 44, figs. 17–20), is suggested.

Measurements.—27.3 mm. along the hinge line, 28 mm. wide across the middle, 18.5 mm. high, 16 mm. thick, 11.9 mm. sinal width, 6.5 mm. sinal depth, 2.7 mm. fold height.

Occurrence.—Trenton group: Cynthiana limestone: Between Colby and Winchester, and also between Millerburg and Pleasant Valley, Kentucky. Catheys formation: Nashville, Columbia, three-fourths mile east of Aspen Hill, etc., Tennessee.

Plesiotypes.—Cat. Nos. 34247, 48611, 65893, U.S.N.M.

PLATYSTROPHIA PRECURSOR LATIFORMIS, new variety.

Plate 44, figs, 5–7.

It is possible to differentiate from the typical specimens of this species a large number which are thinner and decidedly wider in proportion to the height.

Platystrophia foerstei, new species, of the Arnheim formation has the same general physiognomy, but the latter species is usually narrower and has a deeper sinus than this variety.

Measurements.—25.3 mm. along the hinge line, 22 mm. wide across the middle, 15.5 mm. high, 12.3 mm. thick, 10 mm. sinal width, 5 mm. sinal depth, 1.9 mm. fold depth.

Occurrence.—Trenton group: Catheys limestone: Nashville, Williamsport, Columbia, and Maury County, Tennessee.

Cotypes.—Cat. No. 65985, U.S.N.M.

PLATYSTROPHIA PRECURSOR ANGUSTATA, new variety.

Plate 44, figs. 13–16.

A small number of individuals may be selected from among the typical specimens which are narrower, thicker, and have a higher, more compressed fold. They have the physiognomy of *Platystrophia moritura* Cumings, of the Upper Richmond of Kentucky, Indiana, and Ohio, but are, however, narrower, have a shallower sinus and somewhat rounder plications.

Measurements.—24.3 mm. along the hinge line, 25.5 mm. wide across the middle, 18.7 mm. high, 17.5 mm. thick, 13 mm. sinal width, 10 mm. sinal depth, 45 mm. fold depth.

Occurrence.—Trenton group. Catheys limestone: Nashville, Columbia, and Tullahoma, Tennessee. Prosser limestone: Hader, Goodhue County, Minnesota (referred to this variety doubtfully).

Cotypes.—Cat. Nos. 65888, 65890, 48642, U.S.N.M.

MAYSVILLE AND RICHMOND SPECIES.

PLATYSTROPHIA JUVENIS, new species.

Plate 43, figs. 36–41.

This is a sub-equally convex transverse species with a low fold bearing four plications which originate by the bifurcation of two primary plications at the beak, and with a shallow sinus which bears three plications, of which one is primary and occupies a median position and two are secondary implanted plications occupying lateral positions on the sinal slopes. The lateral slopes of the brachial valve are flatly convex and those of the pedicle valve flatly convex and those of the pedicle valve flatly concave. They bear seven and eight plications. The hinge line is generally somewhat less than the width across the middle but may equal this width. The cardinal areas narrow rapidly toward the cardinal extremes. The shell varies from thin to strongly convex.

Platystrophia juvenis resembles *Platystrophia pauciplicata*. Typical specimens are readily distinguished from that species by the more numerous and more closely spaced plications, and by the absence of curved lateral plications.

Measurements.—12 mm. along the hinge line, 14.5 mm. across the middle, 9.6 mm. high, 7 mm. thick, 5.4 mm. sinal width, 4.7 mm. sinal depth, 2 mm. fold depth.

Occurrence.—Maysville group. Near the base of the Fairmount beds; Newport and Covington, Kentucky.

Cotypes.—Cat. No. 65946, U.S.N.M.

PLATYSTROPHIA PAUCIPLICATA Cumings.

Plate 47, figs. 13–15.

Platystrophia lynx pauciplicata CUMINGS, Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 23, figs. 9bis.

Professor Cumings has described this small pauciplicate form from the Maysville of Cincinnati, Ohio. It varies from thin to strongly convex. The low, slightly compressed fold has four plications which result from the bifurcation of two primary plications at the beak. The shallow sinus has one median primary plication and two secondary plications which are situated on the opposite slopes of the sinus.

The hinge line is generally less than the width across the middle. The cardinal areas narrow rapidly. There are five and six plications on the lateral slopes of which the outer ones curve as they approach the lateral margins.

This species differs from *Platystrophia juvenis*, new species, in that it has fewer and more widely spaced plications, in the curvature of the plications next to the cardinal angles, and in posessing a slightly compressed fold.

So many characteristics in common between the two species suggest close relationship, and it is likely that *Platystrophia juvenis* was the direct ancestor of *Platystrophia pauciplicata* if the many intermediate forms are taken as evidence. Transitional forms suggest that *Platystrophia pauciplicata* gave rise to *Platystrophia crassa* by increase in gibbossity and decrease in relative index.[1]

Measurements.—14 mm. along the hinge line, 14.9 mm. wide across the middle, 10 mm. high, 8.3 mm. thick, 7.3 mm. sinal width, 5 mm. sinal depth, 2 mm. fold depth.

Occurrence.—Maysville group: Base of the Fairmount beds, Covington, Kentucky, and Cincinnati, Ohio.

Plesiotypes.—Cat. No. 65947, U.S.N.M.

PLATYSTROPHIA STRIGOSA, new species.

Plate 43, figs. 23–26.

This name is used to designate specimens with thin valves and low spreading folds and shallow sinuses on which the lateral plications are dwarfed. The hinge-line equals or is somewhat greater than the

[1] Relative index is the length of the hinge line divided by the height.

width across the middle. The lateral slopes of the pedicle valve are flatly concave, those of the brachial valve flatly convex. There are generally six sharp plications on the lateral slopes which are broadly spaced and have a slight tendency to curve, as do the lateral plications of *Platystrophia pauciplicata*. The beak is prominent.

Measurements.—15.1 mm. along the hinge line, 14.1 mm. wide across the middle, 10.5 mm. high, 7 mm. thick, 6.5 mm. sinal width, 4.8 mm. sinal depth, 2 mm. fold depth.

Occurrence.—Maysville group: Base of the Fairmount beds at Newport, Kentucky.

Cotypes.—Cat. No. 48613, U.S.N.M.

PLATYSTROPHIA NITIDA, new species.

Plate 43, figs. 42, 43.

The specimens representing this species are small, with spreading folds which scarcely rise above the convexity of the brachial valve; and with broad shallow sinuses which have bent but slightly below the inner edges of the lateral slopes of the pedicle valve. There are six and seven fine, closely spaced plications on the lateral slopes. The slopes of the brachial valves are flatly convex while those of the pedicle valve are flatly concave. The beaks of the pedicle valves are prominent. The cardinal areas narrow rapidly and usually disappear before the cardinal extremes are reached. The hinge-line is somewhat less than the width across the middle.

Measurements.—6 mm. along the hinge line, 8.5 mm. wide across the middle, 6.2 mm. high, 3.6 mm. thick, 3.5 mm. sinal width, 1.5 mm. sinal depth, .5 mm. fold depth.

Occurrence.—Maysville group: Base of Fairmount beds at Cincinnati, Ohio.

Cotypes.—Cat. No. 65945, U.S.N.M.

PLATYSTROPHIA MORROWENSIS (James).

Plate 43, figs. 30–35, 50.

Orthis (?) *morrowensis* JAMES, Cincinnati Quart. Journ. Sci., vol. 1, 1874, p. 21.
Platystrophia morrowensis FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 60, pl. 6, figs. 11*a–e*.

Mr. James has applied this name to certain specimens which were collected from the Cincinnati group of Warren County, Ohio. It is a transversely globose species with sub-equally convex valves. The hinge line varies from one-third to three-fourths the width; the cardinal areas are narrow and the cardinal angles round. The fold is low and spreading; it rises very little above the general convexity of the brachial valve. The sinus is broad and shallow in the middle portion but becomes relatively deep at the front. Both the fold and sinus are almost wanting at the beak.

There are three plications in the sinus and four on the fold in the neanic stage of development. In some specimens this number is not increased during later growth. Some specimens show that in the late neanic and ephebic stages plications are added by intercalation on the slopes of the sinus and bifurcation of the outer plications of the fold; or there may also be implantation in the sinus next to the primary plication and bifurcation of the median plications on the fold.

The lateral slopes of the brachial valve are convex, those of the pedicle valve are flatly concave. They are occupied by eight and nine closely spaced, round plications.

This species has the oval form and low spreading multiplicate sinus of *Platystrophia elegantula*, new species of the Trenton limestone. It is easily distinguished from that species by the ventricosity of the valves and by the shallowness of a fold and sinus next to the beak.

Measurements.—8 mm. along the hinge line, 12 mm. wide across the middle, 8 mm. high, 7 mm. thick, 6.2 mm. sinal width, 3.5 mm. sinal depth, 1 mm. fold depth.

Occurrence.—Maysville group: Corryville beds, Morrow, Cincinnati, etc., Ohio.

Plesiotypes.—Cat. Nos. 41166, 48610, U.S.N.M.

PLATYSTROPHIA CORRYVILLENSIS, new species.

Plate 43, figs. 27–29.

In the Corryville beds at Cincinnati, Ohio, is found a small, transverse, ventricose form with a long hinge line, a low-spreading fold, and broad, shallow sinus. The fold and sinus are occupied by three and four subequal plications and the lateral slopes by eight and nine rounded, closely spaced plications. The slopes of the brachial valve are convex, with a slight concavity next to the cardinal extremes; those of the pedicle valve are flatly concave. The fold rises very little above the general convexity and the sinus is only moderately deep.

Measurements.—14 mm. along the hinge line, 13 mm. wide across the middle, 9 mm. high, 7.5 mm. thick, 6.4 mm. sinal width, 3.2 mm. sinal depth, 1 mm. fold height.

Occurrence.—Maysville group: Corryville beds: Cincinnati, Ohio.

Cotypes.—Cat. No. 65926, U.S.N.M.

PLATYSTROPHIA SUBLATICOSTA, new species.

Plate 45, figs. 17–19.

At several localities a species was found which resembles *Platystrophia laticosta*, but which differ from that species in possessing a low fold throughout its life history, in being thinner and less gibbous, and in having stronger lateral plications of the fold and sinus.

This species consists of specimens of the *Platystrophia precursor* type, but differs in having a slightly higher fold and in having seven instead of nine plications on the lateral slopes.

Measurements.—29 mm. along the hinge line, 27 mm. wide across the middle, 17.5 mm. high, 14.5 mm. thick, 14.5 mm. sinal width, 7.2 mm. sinal depth, 4.5 mm. fold depth.

Occurrence.—Maysville group: Upper Fairmount to Corryville beds; Cincinnati, Ohio, and Madison, Indiana.

Cotypes.—Cat. No. 65941, U.S.N.M.

PLATYSTROPHIA ACUMINATA James.

Plate 46, figs. 5–8.

Orthis (*Platystrophia*) *acuminata* JAMES, Paleontologist, vol. 1, 1878, p. 7.
Platystrophia acuminata FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, pl. 6, fig. 13.

This is a thin form with acuminate hinge extremities. The fold is moderately elevated and compressed, and the lateral plications on the slopes of the fold and sinus are weak. Seven to 10 plications occupy the lateral slopes.

Measurements.—19 mm. along the hinge line, 13 mm. wide across the middle, 9.5 mm. high, 7.5 mm. thick, 7 mm. sinal width, 5 mm. sinal depth, 3.7 mm. fold height.

Occurrence.—Richmond group: Arnheim formation; Waynesville, Ohio, and various localities in Kentucky.

Plesiotype.—Cat. No. 65929, U.S.N.M.

PLATYSTROPHIA FOERSTEI, new species.

Plate 46, figs. 9–12.

This species has transverse equiconvex, thin valves with a hinge line forming the greatest width and with a low spreading fold and shallow sinus which bear subequal plications. The lateral slopes of the brachial valve are flatly convex, those of the pedicle valve flatly concave.

There are generally three plications in the sinus and four on the fold, but this species in common with all other species which have low spreading folds, shows a tendency to add tertiary plications by implantation in the sinus and bifurcation on the fold. There are 8 to 10 plications on the lateral slopes.

Platystrophia foerstei resemble *Platystrophia precursor latiformis* of the Upper Trenton. It has a slightly deeper sinus than the latter form and the lateral slopes next to the sinus are somewhat higher.

Measurements.—19 mm. along the hinge line, 16.8 mm. wide across the middle, 12.7 mm. high, 9.4 mm. thick, 9.1 mm. sinal width, 5.3 mm. sinal depth, 3 mm. fold depth.

Occurrence.—Richmond group: Waynesville, Ohio, Versailles, Indiana. Arnheim formation: Branch Run, one mile east of Seatonville,

1½ miles south of Clark, etc., Kentucky. Liberty beds: Jefferson County, Kentucky.

Cotypes.—Cat. Nos. 40479, 65621, U.S.N.M.

PLATYSTROPHIA FOERSTEI AMPLA, new variety.

Plate 46, figs. 13–16.

This variety differs from typical specimens of the species in being decidedly ventricose and in having a hinge line shorter than the width across the middle.

Occurrence.—Richmond group: Arnheim formation: Lebanon, Ohio. Waynesville formation: Long Run, near mouth of Tate's Creek, and 1¼ miles southeast of Thixton, Jefferson County, and Sunset, Kentucky. Liberty beds: Ravine east of Floyd's Fork, Jefferson County, and Eastwood, Kentucky. Saluda-Whitewater formation: Weisburg, Indiana.

Cotypes.—Cat. Nos. 65635, 65636, 65637, U.S.N.M.

PLATYSTROPHIA ATTENUATA, new species.

Plate 46, figs. 1–4.

Platystrophia acutilirata CUMINGS, Amer. Journ. Sci., ser. 4, vol. 15, 1915, p. 48, fig. 25.

This species is represented by small, transverse shells with low folds and shallow sinuses, which become progressively wider toward the front and are occupied by subequal plications. Most of the specimens are thin, but some of them become decidedly convex.

The hinge line generally forms the greatest width, but it may be less than the width across the middle. The slopes of the brachial valve are flatly convex; those of the pedicle valve flatly concave. They are occupied by six to nine plications on the lateral slopes.

Compared with *Platystrophia acuminata*, it is narrower and has fewer plications. It is smaller and has a proportionately shorter hinge than *Platystrophia foerstei*. It is very similar to *Platystrophia juvenis* but has fewer lateral plications than that species. This species is scarcely distinguishable from some individuals belonging to the Middle Trenton species *Platystrophia amoena*. It generally has fewer plications, thinner valves, and stronger growth varices.

Measurements.—12 mm. along the hinge line, 13 mm. wide across the middle, 9 mm. high, 5.8 mm. thick, 5.8 mm. sinal width, 4 mm. sinal depth, 1 mm. fold height.

Occurrence.—Richmond group: Waynesville formation: Oxford and Warren County, Ohio; Simpsonville, Kentucky; East Fork White River, Indiana.

Cotypes.—Cat. No. 41167, U.S.N.M.

PLATYSTROPHIA CLARKSVILLENSIS Foerste.

Plate 45, figs. 1–4.

Platystrophia clarksvillensis Foerste, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 65, pl. 3, figs. 3, 4.

Platystrophia lynx var. *laticosta* Cumings, 32d. Ann. Rep. Dep. Geol. Nat. Res. Indiana, 1908, pl. 35, figs. 2, 2*a*, 2*b*; Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 32, fig. 17*bb*.

This is a transverse species which bears a marked resemblance to *Platystrophia laticosta*. It is narrower than that species and has more closely spaced, narrower, and more numerous plications on the slopes, there being seven to nine. It differs, also, from *Platystrophia laticosta* in that the slopes are somewhat fuller, which reduces the height of the fold. The lateral plications of the fold and sinus vary from somewhat weaker than the median plications to about equal to them in strength. The hinge line is generally greater in length than the width across the middle, but it may equal it or be somewhat less than the width.

Specimens with a long hinge line have the same general aspect as *Platystrophia cumingsi*, new species, but the latter has a longer hinge and has more numerous plications on the slopes.

Measurements.—25 mm. along the hinge line, 23 mm. wide across the middle, 16 mm. high, 15 mm. thick, 11 mm. sinal width, 10 mm. sinal depth, 4.5 mm. fold depth.

Occurrence.—Richmond group: Arnheim formation: Seatonville and Clark, Kentucky; Waynesville formation: Waynesville and Oregonia, Ohio; Weisburg and numerous other localities in Indiana.

Plesiotypes.—Cat. Nos. 65713, 65726, U.S.N.M.

PLATYSTROPHIA CUMINGSI, new species.

Plate 45, figs. 9–16.

Platystrophia biforata var. *laticosta* Hall and Clarke, Pal. New York, vol. 8, pt. 1, 1892, pl. 5*B*, figs. 6, 7 (not figs. 5, 8, 9).

Platystrophia acutilirata Cumings, Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 32, fig. 17*cc'* (in part); 32nd Ann. Rep. Dept. Geol. Nat. Res. Indiana, 1907, pl. 35, fig. 3, 3*a*.

In the Waynesville member of the Richmond group at Oxford and Waynesville, Ohio, and at Weisburg, Indiana, is a species of *Platystrophia* which possesses intermediate characters between *Platystrophia clarksvillensis* and *Platystrophia acutilirata*. It resembles the former species in that the fold is lower and less compressed than that of *Platystrophia laticosta* and the lateral plications on the slopes of the fold and sinus are stronger than in that species. It also has a greater degree of ventricosity. The specimens resemble *Platystrophia acutilirata* in the possession of acute cardinal extremes and

in having the lateral slopes occupied by numerous plications, there being 10 and 11 on the slopes of the average specimen.

Measurements.—32 mm. along the hinge line, 23.5 mm. wide across the middle, 16 mm. high, 16.2 mm. thick, 11 mm. sinal width, 11 mm. sinal depth, 5 mm. fold depth.

Formation and occurrence.—Richmond group: Waynesville formation: Waynesville, Oregonia and Oxford, Ohio; Weisburg, Indiana. Fernvale limestone: Wilmington, Illinois.

Cotypes.—Cat. Nos. 65699, 65700, 65702, 65703, U.S.N.M.

PLATYSTROPHIA ANNIEANA Foerste.

Plate 46, figs. 20–24.

Orthis annieana JAMES, Cat. Low. Sil. Fossils Cincinnati Group, 1871, p. 10 (*nomen nudem.*).

Platystrophia annieana FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, pl. 6, fig. 14.

In the Bulletin of the Denison University (vol. 16, 1910, pl. 6, fig. 14, *a*, *b*, *c*) Doctor Foerste has figured a species to which Mr. U. P. James had given the catalogue name *Platystrophia annieana*. Figure *a* shows a form in which the hinge line forms the greatest width; figure *c* shows one in which the length of the hinge line about equals the width across the middle. Figure *b* shows a ventricose form with a rounded fold so little elevated as to hardly disturb the even convexity of the brachial valve.

I have before me about 70 specimens from the Waynesville and Liberty formations of Ohio, Indiana, and Kentucky, which undoubtedly belong to the species which he figured. In most specimens the hinge line about equals the width across the middle. I have, however, many in which the hinge line is longer than this width.

The low rounded fold is occupied by four and the sinus by three nearly equal plications. The sinus is moderately deep. The slopes are occupied by 10 and 11 plications. Those of the brachial valve are convex with a slight concavity next to the cardinal angles. The slopes of the pedicle valve are concave.

Measurements.—33.5 mm. along the hinge line, 28.4 mm. wide across the middle, 18.5 mm. high, 14.6 mm. thick, 14 mm. sinal width, 8.4 mm. sinal depth, 2.5 mm. fold depth.

Occurrence.—Richmond group: Waynesville formation: Clarksville, Fort Ancient, Waynesville, Ohio; Bardstown, Kentucky. Liberty beds: Jefferson County, Kentucky, and Clark County, Indiana. Whitewater formation: Richmond, Indiana.

Plesiotypes.—Cat. Nos. 39041, 65651, 65664, U.S.N.M.

PLATYSTROPHIA MORITURA Cumings.

Plate 46, figs. 25–28.

Platystrophia lynx CUMINGS, Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 24.

Platystrophia lynx var. *moritura* CUMINGS, 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 920, pl. 35, fig. 5, 5*a*.

This is a transverse ventricose form with a hinge line longer than the width across the middle. The brachial valve is inflated toward the umbo; the lateral slopes are convex with a slight tendency toward concavity next to the cardinal angles. The slopes of the pedicle valve are slightly concave. The fold ranges in elevation from low with subequal plications to moderately elevated with the two median plications somewhat stronger than the laterals. The sinus is deep in front. The transverse forms are restricted to the Upper Richmond, but subquadrate forms, which evidently belong to this species, are common in the Liberty beds of Kentucky and Indiana. This narrow variety seems to represent transitional forms between this species and *Platystrophia annieana*.

Measurement of a wide specimen.—30 mm. along the hinge line, 29 mm. wide, 20.5 mm. high, 21 mm. thick, 14 mm. sinal width, 14 mm. sinal depth, 5 mm. fold height.

Occurrence.—Richmond group: Whitewater formation: Richmond and northern Ripley County, Indiana. Liberty beds: Railroad cut just east of Eastwood, one-fourth mile east of Fisherville, Kentucky.

Plesiotypes.—Cat. Nos. 65671, 65674, U.S.N.M.

PLATYSTROPHIA ACUTILIRATA (Conrad).

Plate 45, figs. 20–21.

Delthyris acutilirata CONRAD, Journ. Acad. Nat. Sci. Phila., vol. 8, 1842, p. 260, pl. 14, fig. 15.

Orthis (*Platystrophia*) *acutilirata* MEEK, Pal. Ohio, vol. 1, 1873, p. 119, pl. 10, fig. 5.

Orthis biforata var. *acutilirata* WHITE (part), 2nd Ann. Rept. Indiana Bur. Stat. and Geol., 1880, p. 487, pl. 2, figs. 5–9; 10th Rept. State Geol. Indiana, 1881, p. 119, pl. 2, figs. 5–9.

Orthis acutilirata MILLER, Cincinnati Quart. Jour. Sci., vol. 2, 1875, p. 28.

Orthis (*Platystrophia*) *biforata* var. *acutilirata* LESLEY, Geol. Sur. Penna., Rept. p. 4, 1889, p. 508, figs.

Platystrophia acutilirata HALL and CLARKE, Pal. New York, vol. 8, pt. 1, 1892, p. 223.—FOERSTE, Amer. Geol., vol. 31, 1903, p. 340.—CUMINGS, Amer. Journ. Sci., ser. 4, vol. 15, 1903, pp. 33, 35, fig. 18 (part), p. 36, fig. 19 (part).—GRABAU and SHIMER, North Amer. Index Fossils, vol. 1, 1907, p. 258, fig. 308f.—CUMINGS, 32nd Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 912, pl. 35, fig. 3–3*d* (part).—FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 65, pl. 3, figs. 6, 7, 8*a–b*; pl. 4, fig. 9.

Platystrophia acutilirata senex CUMINGS, 32nd Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 913, pl. 35, fig. 4 (not 4*a–c*).

——? *Spirifer shepardi* CASTELNAU, Essai Syst. Sil. Amer. Sept., 1843, p. 42, pl. 14, fig. 15.

This species is spiriferoid, much extended on the hinge. The brachial valve is strongly ventricose; the slopes are inflated to such a degree that the fold rises but slightly above the general convexity. The pedicle valve is less convex than the brachial valve. The slopes are compressed and the inner edges are elevated. This gives a thin appearance to the shell near the cardinal angles and adds to the depth of the conspicuous sinus. There are four plications on the fold and three in the sinus which are of about equal strength. The slopes are occupied by about 13 or more closely spaced plications. The cardinal areas of both valves are strong and broad. The beaks are strongly incurved.

This species has conspicuous gerontic characters. The convexity is so great that it may equal or exceed the height. The shell is thickened centrally and anteriorly to such a degree that the space occupied by the soft parts is exceedingly small when compared with the size of the shell. Both valves are marked by strong growth lines which in the early ephebic stage run out to the cardinal extremes and are closely spaced.

Mr. Conrad reported the Silurian of the Falls of the Ohio as the locality from which his types were collected. Mr. Meek [1] recognized that his figures were in agreement with specimens from Richmond, Indiana. Mr. S. S. Lyon, of Jeffersonville, Indiana, who was familiar with the paleontology of that locality, reported that he had never found such a shell in that area. Mr. Meek sent the Richmond specimens to Mr. Conrad and he identified them as the same as he had figured under the name *Delthyris acutilirata*.

Measurements.—35.5 mm. along the hinge line, 27 mm. wide across the middle, 18.2 mm. high, 20.8 mm. thick, 13.3 mm. sinal width, 11 mm. sinal depth, 4 mm. fold height.

Occurrence.—Richmond group: Whitewater formation: Richmond, etc., Indiana; Oxford and Dayton, Ohio; North Carolina and Louisville R. R. between Wauhatchie and Hooker, Tennessee. Fernvale limestone: Savannah and Wilmington, Illinois. Maquoketa shale: Delafield, Wisconsin.

Plesiotypes.—Cat. No. 48606, U.S.N.M.

PLATYSTROPHIA ACUTILIRATA PROLONGATA Foerste.

Plate 45, fig. 22.

Platystrophia acutilirata, CUMINGS Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 35, fig. 18 (part); 32nd Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, pl. 35, figs. 3*b*, *c*, *d*.

Platystrophia acutilirata prolongata, FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 67, pl. 3, figs. 8*a-b*.

One of the conspicuous variations of *Platystrophia acutilirata* is represented by specimens which have elongated hinge lines and a

[1] Meek, Pal. Ohio, vol. 1, 1873, p. 119, pl. 10, fig. 5.

correspondingly greater number of plications on the lateral slopes, there being from 18 to 30 or more. The acuminate cardinal extremes are so thickened as to be entirely filled with shelly deposit.

Measurements. 43 mm. along the hinge line, 25.6 mm. wide across the middle, 17 mm. high, 15.7 mm. thick, 12 mm. sinal width, 8 mm. sinal depth, 2.8 mm. fold height.

Occurrence.—Richmond group: Whitewater: Usually found associated with typical *Platystrophia acutilirata*.

Plesiotypes.—Cat. No. 65688, U.S.N.M.

PLATYSTROPHIA ACUTILIRATA SENEX Cumings.

Plate 45, fig. 23.

Orthis inflata? James, Cat. Lower Sil. Fos. of the Cincinnati Group, 1871, p. 10 (*nomen nudem*).

Orthis biforata var. *acutilirata* Lesley (part) Geol. Surv. Pennsylvania, Rept. P. 4, 1889, p. 508, figs. 5*c*, 5*f*.

Platystrophia acutilirata Grabau and Shimer, North American Index Fossils, vol. 1, 1907, p. 257, figs. *e*, *g*, *h*, *i*.

Platystrophia accutilirata Cumings, Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 35, fig. 18 (part).

Platystrophia acutilirata var. *senex* (part) Cumings, 32nd Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 913, pl. 35, figs. 4*a*–*c*.

Platystrophia acutilirata inflata Foerste, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, pl. 4, fig. 8.

This variety is represented by specimens which possess retrogressive characters. It passes through an acuminate development in late neanic and early ephebic stages, and then becomes very convex, the depth often exceeding the height. The thickening of the shell and growth varices are more pronounced than in typical specimens. The change in contour is decidedly marked.

Measurements.—35.5 mm. along the hinge line, 38 mm. across the middle, 25 mm. thick, 25.5 mm. high, 14 mm. sinal width, 14.5 mm. sinal depth, 3 mm. fold height.

Occurrence.—Richmond group: Upper part of the Whitewater formation: Found associated with *Platystrophia acutilirata*.

Plesiotype.—Cat. No. 65691, U.S.N.M.

PLATYSTROPHIA ELKHORNENSIS, new species.

Plate 46, figs. 17–19.

From the Elkhorn member of the Richmond along Elkhorn Creek, Wayne County, Indiana, were collected two specimens of a short-hinged globose form with a deep sinus and moderately elevated fold. The slopes are abrupt. Those of the brachial valve are regularly convex; those of the pedicle valve are slightly flattened toward the cardinal angles. There are three plications in the sinus and four on the fold, the two outer ones in each case being the weakest. There

are six and seven plications on the lateral slopes. The surface is marked by strong concentric growth lines.

Measurements.—13 mm. along the hinge line, 22.5 mm. wide just below the middle (this the the greatest width), 18 mm. high, 16.8 mm. thick, 13.5 mm. sinal width, 10.5 mm. sinal depth, 3.3 mm. fold depth.

Occurrence.—Richmond: Elkhorn division: Elkhorn Creek, Wayne County, Indiana.

Holotype.—Cat. No. 48657, U.S.N.M.

b. PONDEROSA SUBGROUP.

PLATYSTROPHIA PREPONDEROSA, new species.

Plate 49, figs. 6–8.

Two Upper Trenton specimens suggest the large globose forms of the genus which occur so abundantly in certain horizons of the Maysville and Lower Richmond, to which Doctor Foerste has given the the name *Platystrophia ponderosa*.

In each the fold is moderately high and compressed. It is occupied by four subequal plications which originate by the bifurcation of two primary plications at the beak. The sinus is moderately deep. It is occupied by three plications of which one is primary and occupies a median position; two are secondary, implanted plications, and occupy positions on the lateral slopes.

The thickness nearly equals the height. The hinge line equals or is somewhat less than the width across the middle. The slopes of the brachial valve are convex; those of the pedicle valve are convex next to the sinus and become slightly concave toward the cardinal angles. They are occupied by eight and nine sharp plications.

Measurements.— 24 mm. along the hinge line (in one specimen the hinge line equals the width across the middle), 26.7 mm. wide across the middle, 20 mm. high, 20 mm. thick, 13 mm. sinal width, 12.5 mm. sinal depth, 6 mm. fold depth.

Occurrence.—Trenton group: Catheys limestone: 2 miles west of Nashville, Tennessee.

Cotypes.—Cat. No. 65871, U.S.N.M.

PLATYSTROPHIA PONDEROSA Foerste.

Plate 49, figs. 1–5, plate 50, figs. 4–7; plate 51, figs. 1–5, plate 52, figs. 1–3, 7–10.

Platystrophia lynx (part) of AUTHORS.

Platystrophia biforata (part) of AUTHORS.

Platystrophia ponderosa FOERSTE, Bull. Sci. Lab., Denison Univ., vol. 14, 1909, p. 225, pl. 4, fig. 14; Ohio Naturalist, vol. 12, 1912, p. 453, pl. 22, fig. 11.

Foerste describes his species as follows:

Platystrophia ponderosa is characterized by large size, thick valves, and quadrangular outline; the brachial valve has a prominent, though rather rounded, median fold,

usually occupied by four plications. The sinus on the pedicle valve is broad, not very deep, and is occupied usually by three plications. The lateral plications vary from seven to nine. Sometimes six occupy the median fold. The shell is greatly thickened interiorly, especially around the deep muscular scar in the pedicle valve.

Occurrence.—Maysville group: Bellevue, Madison, and numerous other localities in Indiana; Oldham County, Kentucky. Leipers: Stockett Hill, White Creek post office, Leipers Creek, etc., Tennessee, Bellevue, Cincinnati, and numerous localities in Ohio.

PLATYSTROPHIA PONDEROSA AUBURNENSIS Foerste.

Plate 49, figs. 9–12.

Platystrophia ponderosa auburnensis FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 14, 1909, p. 226, pl. 4, fig. 15.

Orthis (*Platystrophia*) *biforata* var. *lynx* MEEK, Pal. Ohio, vol. 1, 1873, p. 144, pl. 10, fig. 1.—LESLEY, Geol. Surv. Penna., Rept. P. 4, 1889, p. 509.

Delthyris lynx HALL, Pal. New York, vol. 1, 1847, pl. 32*D*, figs. 1*A*, *B*.

Platystrophia biforata var. *lynx* HALL and CLARKE, Pal. New York, vol. 13, pt. 1, 1892, pp. 202, 223, pl. 5*B*, figs. 1–4.

Platystrophia lynx CUMINGS, Amer. Jour. Sci., vol. 15, 1903, p. 26, fig. 12; p. 28, fig. 14; 32d Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, pl. 35, figs. 1*f*,1*g*.

Platystrophia lynx HAYES and ULRICH, U. S. Geol. Surv., folio, 95, illus. sheet, 1903, figs. 21, 22.

This variety is more globose and has a much shorter hinge line than typical specimens of *Platystrophia ponderosa*. The shell is also narrower and there are fewer plications on the lateral slopes, as the number is usually five or six, becoming obsolete toward the cardinal angles.

Occurrence.—Maysville: Mount Auburn, Cincinnati, etc., Ohio; Madison, etc., Indiana; Oldham County, Kentucky.

Plesiotypes.—Cat. Nos. 65863, 65864, 65867, U.S.N.M.

PLATYSTROPHIA PONDEROSA ARNHEIMENSIS, new variety.

Plate 51, figs. 6–8.

This variety is large, more transverse, and has broader plications on the lateral slopes than the Bellvue form of this species.

Occurrence.—Richmond group Arnheim: Various localities in Jefferson County, Kentucky.

Cotypes.—Cat. Nos. 65854, 65855, 65856, U. S. N. M.

PLATYSTROPHIA FERVALENSIS, new species.

Plate 50, figs. 1–3.

Dr. E. O. Ulrich collected from the Fernvale at Cape Girardeau, Missouri, a large form of which the finely striated surface is the most conspicuous feature. The portion next to the beak has the characteristic coarse plications. As they extend toward the front the plications of both valves bifurcate and other plications are implanted in the original grooves. Toward the front the original plications

are represented by broad, shallow undulations which bear the fine striations.

The lateral slopes of the brachial valve are evenly convex and the fold rises but slightly above the convexity; those of the pedicle valve are convex next to the sinus but become concave toward the cardinal angles. The sinus is almots lacking at the beak, but becomes moderately deep at the front.

There are three plications in the sinus at the beak. Owing to poor preservation the plication pattern is not determinable, but the greater strength of the median plications suggests that it belongs to the *Triplicate Type*. At a distance of 5 ± mm. from the beak, the plications begin to break up and form a finely striated sinus. The brachial valves were so poorly preserved that little could be determined about the plication pattern of the fold except that it was finely striated.

Measurements.—27 mm. along the hinge, 35.5 wide across the middle, and 37 mm. high.

Occurrence.—Richmond Group. Fernvale limestone: Old Quarry southeast of Regenhardts quarry northwest of Cape Girardeau, Missouri.

Cotypes.—Cat. No. 65872, U.S.N.M.

C. HIGH FOLD SUBGROUP.

PLATYSTROPHIA PROFUNDOSULCATA (Meek).

Plate 47, figs. 16–18.

Orthis (*Platystrophia*) *laticosta* var. *profundosulcata* (James) MEEK, Pal. Ohio, vol. 1, 1873, p. 117, pl. 10, figs. 2*a–d*.

Orthis biforata LESLEY Geol. Surv. Pennsylvania, Rept. P. 4, 1889, p. 508, figs. 2*a*, 2*b*.

Platystrophia profundosulcata FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16 1910, p. 58, pl. 6, figs. 15*a–c*.

Platystrophia lynx var. *laticosta* CUMINGS (part), 32nd Ann. Rept. Dept. Geol. and Nat. Res. Indiana, 1907, pp. 918, 919.

Platystrophia profundosulcata is smaller and more gibbous than *Platystrophia laticosta*. The sinus is more profound and the fold higher than specimens of that species of the same size. The sinus bends down so rapidly as to truncate the fold before it has reached as far forward as in other species of the genus.

The hinge line is generally shorter than the width across the middle; in rare cases it may slightly exceed it. The slopes of the pedicle valve are convex next to the sinus and strongly concave near the cardinal extremes; those of the brachial valve are convex. They descend rapidly to the lateral margin and less rapidly to the frontal margin.

The strength of the lateral plications of the fold and sinus varies from subequal to much weaker than the median plications. Four

plications occupy the fold which originate by the bifurcation of two primary plications at the beak. There are three plications in the sinus; one is primary and occupies a median position, two are lateral secondary plications which have been implanted on the slopes of the sinus. The lateral slopes are occupied by five, six, or seven sharp widely spaced plications.

Measurements.—18 mm. along the hinge line, 20.5 mm. wide across the middle, 13 mm. high, 12.5 mm. thick, 8.4 mm. sinal width, 9 mm. sinal depth, 3.6 mm. fold depth.

Occurrence.—Maysville group: Mount Hope and Fairmount beds at Cincinnati, Ohio; Newport, Kentucky; Hays Branch, Indiana, etc.

Plesiotypes.—Cat. No. 65923, U.S.N.M.

PLATYSTROPHIA PROFUNDOSULCATA HOPENSIS Foerste.

Plate 47, figs. 19–21.

Platystrophia profundosulcata hopensis FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, pl. 4, fig. 4.

This variety is more transverse, has a lower fold and shallower sinus than typical specimens of the Mount Hope and Fairmount beds. They are more like young *Platystrophia laticosta*, but the sinus is deeper. The physiognomy of the shell throughout its development suggests that this variety is the ancestor of the forms which Meek took as the types of the species.

Measurements.—19.5 mm. along the hinge, 20.5 mm. wide across the middle, 11.8 mm. high, 13 mm. thick, 10 mm. sinal width, 9 mm. sinal depth, 3.3 mm. fold height.

Occurrence.—Maysville group: Mount Hope beds, Cincinnati, Ohio and Covington, Kentucky.

Plesiotypes.—Cat. No. 65924, U.S.N.M.

PLATYSTROPHIA CRASSA (James).

Plate 47, figs. 1–11.

Orthis (*Platystrophia*) *dentata*? MEEK (not Pander Pal. Ohio, vol. 1, 1873, p. 117, pl. 10, fig. 3.

Orthis (*Platystrophia*) *crassa* JAMES, Cincinnati Quart. Journ. Sci., vol. 1, 1874, p. 20.

Orthis dentata MILLER, Cincinnati Quart. Journ. Sci., vol. 2, 1875, p. 27.

Orthis costata MILLER (not Pander) Cincinnati Quart. Journ. Sci., vol. 2, 1875, p. 33.

Platystrophia crassa HALL and CLARKE, Pal., New York, vol. 8, pt. 1, 1892, p. 223.—GRABAU and SHIMER, North American Index Fossils, vol. 1, 1907, p. 258, figs. 308*A–B*.—FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 59, pl. 4, figs. 5*a–b*.

Orthis (*Platystrophia*) *biforata dentata* LESLEY, Geol. Surv. Pennsylvania, Report P. 4, 1889, p. 508, figs. 3*a–d*.

Orthis centrosa MILLER, North Amer. Geol. and Pal., 1889, p. 356.

Platystrophia biforata var. *crassa* WINCHELL and SCHUCHERT, Geol. Minnesota, vol. 3, 1893, p. 458, pl. 33, figs. 55, 56.—WHITEAVES, Palaeozoic Fossils, vol. 3, pt. 3, Geol. Surv. of Canada, 1897, p. 178.

Platystrophia costata CUMINGS and MAUCK, Amer. Journ. Sci., ser. 4, vol. 14, 1902, p. 14, foot note.—CUMINGS, Amer. Journ. Sci., ser. 4, vol. 15, 1903, pp. 38, 122, figs. 26, 27; 32nd Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 914, pl. 35, figs. 6, 6*a*.

In 1873 Meek described specimens which he had received wrongly labeled as *Platystrophia dentata* Pander. He expressed doubt as to their agreement with the British specimens of *Platystrophia dentata* which are described by McCoy. In 1874 James described this form as *Platystrophia crassa*.

The hinge line is generally somewhat shorter than the width across the middle; in some specimens it is longer than this width. The lateral slopes are swollen next to the fold and sinus and descend rapidly to the free margins. Those of the brachial valve are strongly convex, while those of the pedicle valves are concave toward the cardinal extremes.

James took as his types specimens with high compressed folds and profound sinuses on which the lateral plications were rudimentary or absent. By far the greater number have a compressed, moderately elevated fold with lateral plications somewhat weaker than the median plications, but reaching to the free edge.

In all mature and old specimens the inner edges of the lateral slopes of the pedicle valve are elevated to such a degree as to form a profound sinus. Gibbosity becomes so pronounced in old specimens that the thickness exceeds the height and may equal or nearly equal the width.

The shell is narrower and more globose than that of *Platystrophia laticosta* and *Platystrophia cypha*. It is somewhat like *Platystrophia unicostata crassiformis*, new variety, but it has a lower fold than that form. It also has a greater number of plications on the lateral slopes, as there are seven and eight in this species and only five and six in *Platystrophia unicostata crassiformis*. By selection it is possible to differentiate, from among numerous specimens, a small number of individuals which are shorter and thicker than other members of the species.

It is also possible to differentiate an occasional pauciplicate form with a hinge line decidedly shorter than the other specimens. There are four, rarely five and six, coarse, sharp, and broadly spaced plications on the lateral slopes. Specimens representing this mutation are smaller than other members of the species.

Occurrence.—Maysville group: All mutations are found in association in the Fairmount beds at Cincinnati, Ohio; Covington, Kentucky; and Madison, Indiana, etc.

Plesiotypes.—Cat. Nos. 35566, 48604, U.S.N.M.

PLATYSTROPHIA CRASSA, variety.

Plate 47, figs. 12.

Specimens have been found in the Arnheim and Waynesville at several localities which closely resemble *Platystrophia crassa*. The only characteristic which seems to distinguish these from the Fairmount specimens is their somewhat longer hinge line.

Measurements.—15 mm. along the hinge, 16.8 mm. wide across the middle, 15.5 mm. high, 12.6 mm. thick, 9.3 mm. sinal width, 7.2 mm. sinal depth, 4 mm. fold depth.

Occurrence.—Richmond group, Waynesville formation: Mouth of Bull Creek, Clark County, Indiana; Greenwell Ford, Kentucky. Arnheim: One and one-half miles south of Clark, Jefferson County, Kentucky.

Plesiotype.—Cat. No. 65953, U.S.N.M.

PLATYSTROPHIA LATICOSTA (Meek).

Plate 48, figs. 11–13.

Delthyris lynx HALL, Pal. New York, vol. 1, 1847, pl. 32*D*, figs. 1 *O*, *P*, *Q*.

Orthis laticostata JAMES, Cat. Sil. Foss. Cincinnati Group, 1871, p. 10 (*nomen nudem*).—MILLER, Cincinnati Quart. Jour. Sci., vol. 2, 1875, p. 27.

Orthis (*Platystrophia*) *biforata* var. *laticosta* MEEK, Pal. Ohio, vol. 1, 1873, p. 116, pl. 10, fig. 4.—LESLEY, Geol. Surv. Pennsylvania, Rep. P. 4, 1889, p. 509, figs. 4*a-d*.

Platystrophia biforata var. *laticosta* HALL and CLARKE, Pal. New York, vol. 8, pt. 1, 1892, p. 223, pl. 5*B*, figs. 5, 8, 9 (not 6, 7).

Platystrophia lynx var. *laticosta* CUMINGS and MAUCK, Amer. Journ. Sci., ser. 4, vol. 14, 1902, p. 4.—CUMINGS (part), Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 28 (footnote) p. 29, figs. *e-e'''*.

Platystrophia laticosta CUMINGS (part), Amer. Journ. Sci., vol. 15, 1903, pp. 30, 122.

Platystrophia laticosta FOERSTE, Amer. Geol., vol. 31, 1903, p. 334.—GRABAU and SHIMER, N. A. Index Fossils, vol. 1, 1907, p. 258.—FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, pl. 3, figs. 1*a*, *b*, 2.

Platystrophia laticosta has a transverse shell with seven plications on the lateral slopes. The fold is compressed and the sinus deep. The depth of the sinus is increased by elevation of the inner edges of the lateral slopes of the pedicle valve, which is the result of lateral compression.

The slopes of the brachial valve have a convex curve from the front to the cardinal margin with the steepest part of the curve toward the hinge. The curve from the edge of the fold to the lateral margin is flatly convex.

The chief distinction between *Platystrophia laticosta* and *Platystrophia cypha* is one of degree. Both have high compressed folds and deep sinuses, but there is less compression of the fold and less depth to the sinus in the former. The lengthwise convexity of the

lateral slopes is also less in *Platystrophia laticosta* than in *Platystrophia cypha.*

The lateral plications of the fold and sinus are weak, but they have never entirely disappeared. Specimens of *Platystrophia cypha* often have one or both of these plications entirely missing.

Similar specimens occur in the Waynesville beds. The latter, are ventricose, more transverse and bear nine instead of seven plications on the lateral slopes.

Occurrence.—Maysville group. Leipers formation: Nashville, Tennessee. Bellevue member: Maysville, Bullittsville, and Oldham County, Kentucky; Madison, Vevay, Lawrenceburg and Manchester, Indiana. Bellevue and Corryville beds: Cincinnati and elsewhere in Ohio.

Plesiotypes.—Cat. Nos. 48605, 50946, U.S.N.M.

PLATYSTROPHIA UNICOSTATA Cumings.

Plate 48, figs. 4–7.

Platystrophia unicostata CUMINGS, Amer. Journ. Sci., ser. 4, vol. 15, 1903, pp. 28–29, figs. 15 *a–d*, p. 31.—FOERSTE, Bull. Sci. Lab. Denison Univ., vol. 16, 1910, pl. 4, fig. 6.

Professor Cumings has described this form as a uniplicate *Platystrophia laticosta* of the Upper Maysville. It differs from that species in that it is more compressed, is narrower and has a higher fold and deeper sinus.

The compression, the high fold, and deep sinus and loss of lateral plications of the fold and sinus agree with *Platystrophia cypha* as do also the contour of the lateral slopes. The slopes of the brachial valve bend rapidly toward the cardinal margin, somewhat less rapidly to the frontal margin, and with almost no bend to the lateral margin. The slopes of the pedicle valve are profoundly elevated along the inner margins which descend with a decided slope and form a deep concavity.

This species differs from *Platystrophia cypha* in that the hinge line is not more than one-fourth greater than the width across the middle and the lateral plications are fewer, coarser and more widely spaced, as there are only five and six. Specimens in the United States National Museum labeled by James as *Platystrophia cypha* belong to this species. James took as his types of *Platystrophia cypha* shells which were conspicuously prolonged along the hinge-line and with 10 or 12 plications on each of the lateral slopes.

Platystrophia unicostata is connected with *Platystrophia laticosta* by all degrees of variants. Some individuals have three plications on the sinus and four on the fold; in this case the lateral plications are

very weak. Some individuals have one lateral plication on the fold and one in the sinus fairly well developed, while those on the opposite side merely appear or are entirely absent. The loss of these plications is due to obsolescence. Among the specimens in Columbia University there were several which showed this loss to be due to retardation in development, but none of the specimens belonging to the National Museum show this and the Columbia specimens are not regarded as representative.

Measurements.—28.5 mm. along the hinge line, 24 mm. wide across the middle, 18.3 mm. high, 22 mm. thick, 13 mm. sinal width, 16 mm. sinal depth, 6 mm. fold depth.

Occurrence.—Maysville Group. Bellevue: Madison and Vevay, Indiana; Maysville: Near Lebanon, Kentucky. Corryville: Cincinnati, Ohio.

Plesiotypes.—Cat. Nos. 39037, 65968, 65969, 65970, U.S.N.M.

PLATYSTROPHIA UNICOSTATA CRASSIFORMIS, new variety.

Plate 48, figs. 8–10.

This variety is represented by narrow gibbous specimens which show strong lateral compression. The hinge line equals or is greater than the width across the middle. The fold is narrow and strongly elevated; the sinus is profound. In most specimens there are two plications on the fold and one in the sinus, but in other specimens there is one weak lateral plication on one or both sides of the fold and sinus. The lateral slopes of the brachial valve are strongly convex, those of the pedicle valve strongly concave. The slopes are occupied by four to six plications.

This variety has been confused with *Platystrophia crassa*. It has a more angular outline, the fold is higher, the sinus deeper, and the lateral plications are broader and more broadly spaced. It is narrower than *Platystrophia unicostata*. The many characteristics in common between this variety and *Platystrophia cypha* would indicate that it belonged to that species, but the growth stages and many variants point to *Platystrophia laticosta* as the stock from which this variety developed.

Measurements.—25 mm. along the hinge line, 22.2 mm. wide across the middle, 17.1 mm. high, 19 mm. thick, 11.5 mm. sinal width, 11.5 mm. sinal depth, 4.5 mm. fold depth.

Occurrence.—Maysville group. Leipers formation; Boodlettsville, Tennessee. Bellevue member: Maysville, Kentucky; Bellevue; Madison, Indiana.

Cotypes.—Cat. No. 65965, U.S.N.M.

PLATYSTROPHIA CYPHA (James)

Plate 47, figs. 22–25; plate 48, figs. 14–16.

Delthyris lynx HALL, Pal. New York, vol. 1, pl. 32*D*, figs. 1 *R. S. T. U.*

Orthis (*Platystrophia*) *cypha* JAMES, Cincinnati Quart. Jour. Sci., vol. 1, 1874, p. 20; not figured.

Platystrophia cypha CUMINGS, Amer. Journ. Sci., ser. 4, vol. 15, 1903, p. 39, footnote.—FOERSTE, Amer. Geol., vol. 31, 1903, p. 341; Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 61, pl. 4, fig. 10*a–b*; pl. 5, fig. 11; pl. 4, fig. 12; Ohio Naturalist, vol. 12, 1912, p. 453, pl. 22, fig. 5.

Platystrophia lynx var. *cypha* CUMINGS, 32nd Ann. Rept. Dept. Geol. Nat. Res. Indiana, 1908, p. 917.

Mr. James described this species as a transverse gibbous form with a hinge so long as to form spinelike projections; a profound sinus; a remarkably elevated fold; convexity equaling the width across the middle; one strong plication in the sinus and an obscure rudimentary one on each side; and twenty-two to twenty-six angular costae on each valve.

Doctor Foerste saw the specimens preserved in the James collection in the Walker Museum of Chicago University as types of *Platystrophia cypha*. He says:[1]

> The one numbered 2326 * * * is prolonged conspicuously along the hinge line; it possesses 12 plications; on one side of the shell extend to about three-quarters of an inch from the beak. The spinelike prolongation at the opposite end of the hinge line has been broken off. The other specimens can not be regarded as types since in these the prolongation of the shell along the hinge line does not exceed an eighth of an inch and the number of plications on each side of the fold is 7 or 8 instead of 10 or 12. Although all of these specimens can not be regarded as original types, they evidently belong to the same species if my interpretation of the species is correct.

I have before me about 200 specimens of this species, and those which apply to this description are found at various horizons of the Arnheim of Tennessee, Kentucky, Ohio, and Indiana. I have one specimen from the Arnheim of Lebanon, Kentucky, which seems to agree in dimensions with those which Mr. James took as his types. It is 40 mm. along the hinge and 23.5 mm. wide across the middle. There are 12 plications on the lateral slopes. This specimen, however, has four plications in the sinus and five on the fold. Individuals of nearly every species of the triplicate group have been found which have more than three plications in the sinus and four on the fold, and this specimen represents one of these mutations.

The average individual of these Arnheim forms has a hinge line which is about one-fourth greater than the width across the middle, and has 9 or 10 plications on the lateral slopes. The high compressed fold has two strong and two weak plications; the profound sinus has a strong median plication and two weak lateral plications.

[1] Bull. Sci. Lab. Denison Univ., vol. 16, 1910, p. 62.

The slopes of the brachial valve have a strongly convex curve from the cardinal to the frontal margin. There is only a slight convex curve from the fold to the lateral margins. The slopes of the pedicle valve are strongly concave, the greatest concavity being behind the cardinal angles. Specimens with fewer lateral plications which are found associated with those just described are placed in this species as they are in agreement in all other characters.

Doctor Foerste has applied the name *Platystrophia cypha conradi* (see pl. 47, figs. 26, 27, Cat. No. 66028, U.S.N.M.) to that type of shell which is much prolonged along the hinge-line, bears numerous plications on the lateral slopes, and has a less compressed fold and sinus which bears stronger lateral plications than is found in typical specimens of *Platystrophia cypha.*

Platystrophia cypha resembles *Platystrophia unicostata* and *Platystrophia unicostata crassiformis.* The chief difference lies in its greater width and correspondingly greater number of plications on the lateral slopes.

Measurements.—33 mm. along the hinge, 25.5 mm. wide across the middle, 17.5 mm. high, 17.5 mm. thick. 13.5 mm. sinal width. 11.5 mm. sinal depth, 6 mm. fold depth.

Occurrence.—Richmond group: Arnheim formation: Waynesville and Lebanon, Ohio; Seatonville, Bardstown, Lebanon, near Springfield, Fisherville, etc., Kentucky; and Madison, Indiana.

Plesiotypes.—Cat. Nos. 66001, 66009, U.S.N.M.

PLATYSTROPHIA CYPHA TUMIDA, new variety.

Plate 48, figs. 17–20.

Among the specimens of *Platystrophia cypha* found in the Arnheim of Tennessee, Kentucky, Ohio, and Indiana occurs a variety with a tumid shell in which the thickness equals the width across the middle and equals or exceeds the height. The hinge line forms the greatest width. Four specimens from Mount Washington, Kentucky, have the hinge line greatly extended but in most specimens it is about a third greater than the width across the middle. The fold is high and slightly less compressed than in typical specimens of the species. The sinus is profound in front and has a direction at right angles to the direction of the posterior portion of the sinus. The lateral plications of the fold and sinus are on the average relatively strong but they are always weaker than the median plications. The number of plications on the lateral slopes vary from 8 to 10.

The slopes of the brachial valve are swollen. The descent in all directions is abrupt, but it is most abrupt toward the cardinal margin. The lateral slopes of the pedicle valve are greatly elevated next to the sinus. Strong compression of this valve has resulted in a decidedly concave outline.

Compared with *Platystrophia wallowayi* this form has more acuminate cardinal extremes with concave rather than convex lateral margins. The slopes of the brachial valve are more tumid and those of the pedicle valve more compressed than in the latter species. It has many of the characteristics of *Platystrophia unicostata*. The slopes of the brachial valve are more swollen and those of the pedicle valve more compressed than that form and it also has a greater number of plications on the slopes.

The inflated brachial valve suggests relationship to *Platystrophia clerksvillensis* and *Platystrophia cumingsi* and the stratigraphic position of the three forms strengthens this view, but this variety marks the culmination of a development toward decrease in width and increase in thickness. It would not be likely to give rise to species whose development was toward increase in the width of the shell.

Measurements.—33.5 mm. along the hinge line, 25.9 mm. wide across the middle, 19.3 mm. high, 25 mm. thick, 16.8 mm. sinal width, 16 mm. sinal depth, 6.5 mm. fold height.

Occurrence.—Richmond group: Arnheim formation: One mile south of Mount Washington, Greenwell Ford, 1½ miles south of Clark, etc., Kentucky; 4 miles northeast of Gallatin and Goodlettsville, Tennessee; Waynesville and Clarksville, Ohio; Southeastern Indiana.

Holotype.—Cat. No. 66069, U.S.N.M.

PLATYSTROPHIA CYPHA ARCTA, new variety.

Plate 48, figs. 1–3.

Another variant of *Platystrophia cypha* has a thinner valve and a more compressed fold and sinus than other members of the species and the lateral plications on the slopes of the fold and sinus are weak. Sometimes they become obsolete before reaching the frontal margin. Most of the specimens have subquadrate cardinal extremes; a few specimens are slightly elogate on the hinge-line. The convexity of the brachial valve and concavity of the pedicle valve are not so marked as in other members of the species. Nine and ten closely spaced plications occupy the lateral slopes.

This variety is easily distinguished by its thin fold, narrow form, and closely spaced plications.

Measurements.—35 mm. along the hinge line, 33 mm. wide across the middle, 17.5 mm. high, 13.5 mm. thick, 12 mm. sinal width, 9.5 mm. sinal depth, 6 mm. fold depth.

Occurrence.—Richmond group. Arnheim formation: Wyoming, Sunset, ¼ mile east of Fisherville, Clark, Greenwell Ford Section, Bullitt County, Kentucky; Gallatin, Tennessee; Waynesville, Ohio.

Cotypes.—Cat. No. 66045, U.S.N.M.

PLATYSTROPHIA CYPHA BELLATULA, new variety.

Plate 47, figs. 28-30.

In the Waynesville formation of Ohio and Kentucky there is a small variety of *Platystrophia cypha* with six, seven, or eight plications on the lateral slopes. This variety has many characteristics in common with *Platystrophia unicostata*. It is smaller and shorter than that species, and has somewhat narrower plications on the lateral slopes.

Measurements.—25.2 mm. along the hinge line, 21.5 mm. wide across the middle, 14 mm. high, 17 mm. thick, 9.5 mm. sinal width, 13 mm. sinal depth, 4.5 mm. fold depth.

Occurrence.—Richmond group: Waynesville formation; Waynesville and Clarksville, Ohio; Westport, Kentucky.

Cotypes.—Cat. No. 66021, U.S.N.M.

PLATYSTROPHIA WALLOWAYI Foerste.

Plate 45, figs. 5–8.

Platystrophia wallowayi FOERSTE, Ohio Naturalist, vol. 12, 1912, p. 453, pl. 22, fig. 6.

This represents a globose form with a hinge line somewhat shorter than the width across the middle, a high, broad, rounded fold and broad deep sinus. The brachial valve is strongly convex. The pedicle valve is not as deep as the brachial valve; it is convex next to the sinus, but becomes slightly concave toward the cardinal angles. There are usually four plications on the fold and three in the sinus but in some specimens there are five or more plications on the fold and four or more in the sinus. There are usually 9 or 10 plications on the lateral slopes. Mature specimens have strong growth lines.

Measurements.—19 mm. along the hinge line, 22.6 mm. wide below the middle (greatest width), 17.3 mm. high, 17.2 mm. thick, 13.7 mm. sinal width, 11.3 mm. sinal depth, 6.7 mm. fold height.

Occurrence.—Richmond group: Arnheim formation: Walloway Creek, near Boston, Bardstown, etc., Kentucky; Southeastern Indiana.

Plesiotypes.—Cat. Nos. 39043, 65981, U.S.N.M.

EXPLANATION OF PLATES.

PLATE 42.

All figures on this plate are natural size.

FIGS. 1, 2. *Platystrophia uniplicate*, new species, p. 405.

1. Pedicle valve showing one plication in the sinus.
2. Brachial valve. The low fold bearing two plications is typical (same specimen as fig. 1).

Trenton limestone near Lake Champlain, New York.

FIGS. 3–6. *Platystrophia trentonensis*, new species, p. 407.

3. Pedicle valve. The figure shows the presence of three plications in the sinus.
4. Pedicle valve of a long-hinged specimen.

Trenton group (Prosser limestone) Decorah, Iowa.

5. Brachial valve showing the bifurcation of the median plication.
6. Anterior view.

Trenton group (Prosser limestone). Fountain, Minnesota.

FIGS. 7, 8. *Platystrophia precedens*, new species, p. 405.

7. Pedicle valve showing two plications in the sinus merging into one at the beak.

Trenton group (Curdsville limestone), Mercer County, Kentucky.

8. Pedicle valve of a plump specimen. The presence of one plication in the sinus at the beak is shown.

Trenton limestone near Lake Champlain, New York.

FIGS. 9–11. *Platystrophia trentonensis champlainensis*, new variety, p. 407.

9. Pedicle valve. The biplicate plication pattern is well shown.
10. Cardinal view showing the short hinge line.
11. Brachial valve. The figure illustrates the bifurcation of the median plication.

Trenton limestone near Lake Champlain, New York.

FIGS. 12–14. *Platystrophia trentonensis perplana*, new variety, p. 407.

12. Pedicale valve showing the intercalation of a median plication in the sinus.
13. Cardinal view. The thin form is typical.

Trenton group (Curdsville limestone), Crossville Quadrangle, Tennessee.

14. Brachial valve. The figure shows the biplicate arrangement of the plications of the fold.

Trenton group (Curdsville limestone), Mercer County, Kentucky.

FIGS 15–19. *Platystrophia hermitagensis*, new species, p. 409.

15. Pedicle valve showing the broad shallow sinus.

Trenton group (Hermitage limestone), Payton's Creek, 6 miles northwest of Carthage, Tennessee.

16. Brachial valve showing the low multiplicate fold.
17. Pedicle valve. This specimen lacks the usual median plication in the sinus.
18. Anterior view. The thin form is characteristic.
19. Cardinal view. The presence of two plications on the fold at the beak is shown in this figure.

Trenton group (Hermitage limestone), Auburn, Tennessee.

FIG. 20. *Platystrophia*, species.

20. A specimen of the Biplicate Group with two plications in the sinus. Only one valve was found.

Trenton group (Prosser limestone), Cannon Falls, Minnesota.

FIGS. 21, 22. *Platystrophia regularis* Shaler, p. 405.

21. Pedicle valve showing the two plications in the sinus. The outer margin has been broken away.
22. Brachial valve partly buried in limestone. The three plications on the fold are typical.

Richmond group (Ellis Bay), Cliff, one-half mile east of Junction Cliff, Anticosti Island.

FIG. 23. *Platystrophia reversata* (Foerste), p. 408.

23. Pedicle valve showing the multiplicate sinus. The outer edges have been broken away.

Albion group (Brassfield limestone), Dayton, Ohio.

FIG. 24. *Platystrophia daytonensis* (Foerste), p. 406.

24. Brachial valve. The three plications on the fold are typical.

Albion group (Brassfield limestone), Nelson County, Kentucky.

FIGS. 25–28. *Platystrophia brachynota* (Hall). p. 408.

25. Cardinal view illustrating the short hinge.
26. Brachial valve of the same specimen. The figure shows the five plications on the fold.

Niagarian group (Louisville limestone), Louisville, Kentucky.

27. Pedicle valve. The presence of four plications in the sinus is characteristic.
28. Brachial valve of a small specimen.

Albion group (Brassfield limestone), Nelson County, Kentucky.

FIGS. 29–31. *Platystrophia*, species.

29. Brachial valve. The fold scarcely rises above the general convex outline.
30. Cardinal view.
31. Pedicle valve. The shallow sinus is characteristic. The plication pattern of the fold and sinus shows that this species belongs to the biplicate group.

Middle Ordovician (Wesenberg limestone), near Wesenberg, Esthonia, Russia.

FIGS. 32–35. *Platystrophia*, species.

32. Cardinal view showing the short hinge-line and globose form.
33. Brachial valve. The three plications of the fold is typical. The varices are so strong as to be almost lamellose.
34. Pedicle valve.
35. Anterior view. This species has two plications in the sinus. The plication pattern of the fold and sinus places this species in the biplicate group.

Upper Ordovician (F1) Kurküll, Russia.

FIGS. 36–38. *Plastystrophia rhynchonelliformis*, new species, p. 413.

36. Brachial valve showing a compressed fold.
37. Pedicle valve. The triplicate arrangement of the plications of the sinus is typical.
38. Cardinal view. The short hinge line is typical.

Trenton limestone Ellisburg, New York.

FIGS. 39–41. *Platystrophia extensa*, new species, p. 410.

39. Pedicle valve showing the triplicate plication pattern.

Trenton group (Hermitage limestone), two miles north of Hartsville, Tennessee.

40. Cardinal view. The thin valves are characteristic.
41. Brachial valve.

Trenton group (Hermitage limestone), Auburn, Tennessee.

FIGS. 42–43. *Platystrophia daytonensis laurelensis*, new variety, p. 406.

42. Brachial valve showing the presence of three plications on the fold.
43. Pedicle valve. The two plications in the sinus show the biplicate arrangement.

Niagara group (Laurel limestone), St. Paul, Indiana.

PLATE 43.

All figures on this plate are natural size.

FIGS. 1–8. *Platystrophia amoena*, new species, p. 412.

1. Brachial valve. The figure shows the low spreading fold.

Trenton group (Bigby limestone), Cynthiana, Kentucky.

2. Brachial valve of a mutation which has six plications on the fold.
3. Brachial valve of a normal individual.

Trenton limestone, Trenton Falls, New York.

4. Brachial valve of a narrow specimen.
5. Anterior view showing the low fold, shallow sinus and thin valves.
6. Pedicle valve of a normal individual.

Trenton group (Bigby limestone), Versailles, Kentucky.

7. Pedicle valve of a mutation which has four plications in the sinus.
8. Brachial valve of a normal individual.

Trenton group (Bigby limestone), Frankfort, Kentucky.

FIGS. 9–13. *Platystrophia amoena longicardinalis*, new variety, p. 412.
9. Pedicle valve. The figure shows the shallow sinus.
10. Brachial valve. The low spreading fold is typical.
Trenton limestone, Trenton Falls, New York.
11, 12. Brachial valves.
13. Cardinal view showing the ventricosity. All the specimens show the characteristic acuminate hinge extremities,
Trenton group (Prosser limestone), Fountain, Minnesota.

FIGS. 14–17. *Platystrophia amoena robusta*, new variety, p. 412.
14. Cardinal view. The plump form is characteristic.
15. Pedicle valve. The shallow sinus is illustrated.
16. Anterior view. The figure illustrates the shallow sinus.
17. Brachial valve showing the characteristic strong growth lines.
Trenton limestone, Trenton Falls, New York.

FIGS. 18–22. *Platystrophia globosa*, new species, p. 413.
18. Pedicle valve. The triplicate plication pattern is well shown.
19. Cardinal view. The plump form is typical.
20. Anterior view showing the broad sinus.
21. Brachial valve illustrating the broad low fold.
Trenton group, Nashville, Tennessee.
22. Brachial valve.
Trenton limestone, Ellisburg, New York.

FIGS. 23–26. *Platystrophia strigosa*, new species, p. 417.
23. Anterior view showing the typical thin form, low fold and shallow sinus.
24. Pedicle valve. The broad sharp plications are characteristic.
25. Brachial valve, of a mutation with five plications on the fold.
26. Brachial valve of a somewhat larger specimen.
Maysville group (Fairmount), Newport, Kentucky.

FIGS. 27–29. *Platystrophia corryvillensis*, new species, p. 419.
27. Cardinal view showing the ventricose brachial valve and long hinge line.
28. Brachial valve. The fold scarcely rises above the general convexity of the valves.
29. Pedicle valve. The broad sinus is typical.
Maysville group (Corryville beds), Cincinnati, Ohio.

FIGS. 30–35. *Platystrophia morrowensis* (James), p. 418.
30. Lateral view. The globose form is characteristic.
31. Pedicle valve showing the low spreading fold.
32. Cardinal view. The short hinge line is characteristic.
33. Pedicle valve of an individual with three plications in the sinus.
Maysville group (Corryville beds), Morrow, Cincinnati, etc., Ohio.
34. Pedicle valve of a longer hinged individual.
35. Brachial valve of a very short hinged specimen.
Maysville group (Corryville beds), Cincinnati, Ohio.

FIGS. 36–41. *Platystrophia juvenis*, new species, p. 416.
36. Brachial valve of a typical specimen.
37. Brachial valve of a mutation with seven plications on the lateral slopes.
38. Pedicle valve of a mutation which approaches *Platystrophia pauciplicata*.
39. Pedicle valve of a typical specimen.
40. Anterior view showing the even convexity of the valves.
41. A group attached to a bryozoan frond.
Maysville group (Fairmount beds), Newport and Covington, Kentucky.

FIGS. 42–43. *Platystrophia nitida*, new species. p. 418.
42. Brachial valve showing the characteristic low spreading fold.
43. Cardinal view. The short hinge line is characteristic.
Maysville group (Fairmount), Cincinnati, Ohio.

FIGS. 44–47. *Platystrophia elegantula*, new species, p. 410.
44. Pedicle valve. The multiplicate sinus is characteristic.
45. Cardinal view showing the short hinge.
46. Brachial valve. The outer plications are shown to curve.
47. Anterior view. This species has a low rounded fold and broad sinus. These specimens show the characteristic multiplicate sinus.
Trenton group (Bigby limestone), Frankfort, Kentucky.

FIG. 48. *Platystrophia elegantula triplicata*, new variety, p. 411.
48. Pedicle valve showing the presence of only three plications in the sinus.
Trenton limestone, Ellisburg, New York.

FIG. 49. *Platystrophia elegantula amplisulcata*, new variety, p. 411.
49. Pedicle valve with seven plications in the sinus.
Trenton group (Bigby limestone), Frankfort, Kentucky.

FIG. 50. Portion of the outer surface of a *Platystrophia morrowensis* James, showing the granular character.

PLATE 44.

All figures on this plate are natural size.

FIGS. 1–4. *Platystrophia precursor* Foerste, p. 415.
1. Brachial valve. This figure shows the subequal plications on the fold.
2. Pedicle valve. The broad sinus is typical.
3. Anterior view showing the broad, moderately deep sinus.
4. Cardinal view showing the equiconvex valves.
Trenton group (Catheys formation), Nashville, Tennessee.

FIGS. 5–7. *Platystrophia precursor latiformis*, new variety, p. 415.
5. Cardinal view showing the long hinge line.
6. Pedicle valve. The triplicate plication pattern is well shown.
7. Brachial valve.
Trenton group (Catheys formation), Nashville, Tennessee.

FIGS. 8–11. *Platystrophia colbiensis* Foerste, p. 414.
8. Brachial valve of an average individual.
9. Pedicle valve of an average individual.
Trenton group (Catheys formation), Edgefield Junction, Tennessee.
10. Pedicle valve of a large specimen.
11. Brachial valve of same specimen.
Trenton group (Catheys formation), Nashville, Tennessee.

FIG. 12. *Platystrophia colbiensis mutata* Foerste, p. 414.
12. Pedicle valve showing five plications in the sinus.
Trenton group, 4 miles east of Mount Pleasant, Tennessee.

FIGS. 13–16. *Platystrophia precursor angusta*, new variety, p. 416.
13. Brachial valve of a specimen which is referred to this variety.
Trenton group (Prosser limestone), Hader, Goodhue County, Minnesota.
14. Pedicle valve showing the typical narrow form.
15. Brachial valve of another specimen.
16. Anterior view. The figure shows the thick valves.
Trenton group (Catheys formation), Nashville, Tennessee.

FIGS. 17–20. *Platystrophia precursor profunda*, new variety, p. 415.
17. Pedicle valve. The figure shows a deep sinus.
18. Brachial valve. The broad fold is characteristic.
19. Cardinal view showing the brachial valve to be deeper than the pedicle valve.
20. Anterior view. The deep sinus is characteristic.
Trenton group (Catheys formation), Nashville, Tennessee.

PLATE 45.

All figures on this plate are natural size.

FIGS. 1–4. *Platystrophia clarksvillensis* Foerste, p. 422.

1. Cardinal view showing the extended hinge line.
2. Pedicle valve. The specimen shows the subequal plications in the sinus
3. Anterior view. The prominent sinus is characteristic.
   Richmond group (Waynesville formation), Waynesville, Ohio.
4. Brachial valve.
   Richmond group (Waynesville formation), Oregonia, Ohio.

FIGS. 5–8. *Platystrophia wallowayi* Foerste, p. 438.

5. Anterior view showing the great depth of the sinus.
   Richmond group (Arnheim), Southeastern Indiana.
6. Lateral view. The robust form is characteristic.
7. Brachial valve. The figure shows the typical strong varices.
8. Pedicle valve of a mutation with four plications in the sinus.
   Richmond group (Arnheim). Long Run, three-fourths mile above Boston, Jefferson County, Kentucky.

FIGS. 9–13. *Platystrophia cumingsi*, new species, p. 422.

9. Pedicle valve. The figure represents an average specimen.
   Richmond group (Waynesville formation), Oxford, Butler County, Ohio.
10. Cardinal view. The ventricose form is characteristic.
    Richmond group (Waynesville formation), Oregonia, Ohio.
11. Brachial valve showing the strong plications on the slopes of the fold.
12. Anterior view of a mutation which has four plications in the sinus.
    Richmond group (Waynesville formation), Waynesville, Ohio.
13. Brachial valve. The right side has been crushed.
    Richmond group (Fernvale limestone), Wilmington, Illinois.

FIGS. 14–16. *Platystrophia* cf. *cumingsi*, new species, p. 422.

14. Anterior view showing shallow sinus, low fold and thin valves.
15. Pedicle valve. The extended cardinal extremes is characteristic.
16. Brachial valve.
    Richmond group, near Waynesville, Ohio.

FIGS. 17–19. *Platystrophia sublaticosta*, new species, p. 419.

17. Anterior view. The shallow sinus and low fold are typical.
18. Brachial valve showing the strong plications on the slopes of the fold.
19. Pedicle valve. (Same specimen as fig. 17.)
    Maysville group (Upper Fairmount), Cincinnati, Ohio.

FIGS. 20–21. *Platystrophia acutilirata* (Conrad), p. 424.

20. Interior of pedicle valve.
21. Brachial valve. The low broad fold is typical.
    Richmond group (Whitewater), Richmond, Indiana.

FIG. 22. *Platystrophia acutilirata prolongata* Foerste, p. 425.

22. Pedicle valve showing the extended cardinal extremities.
    Richmond group (Whitewater formation), Richmond, Indiana.

FIG. 23. *Platystrophia acutilirata senex* Cumings, p. 426.

23. Brachial valve. The narrow form is characteristic.
    Richmond group (Upper Whitewater formation), Richmond, Indiana.

PLATE 46.

All the figures on this plate are natural size.

FIGS. 1–4. *Platystrophia attenuata*, new species, p. 421.

1. Pedicle valve. The figure illustrates the broad shallow sinus.
2. Anterior view showing the characteristic thin form.

FIG. 3. Brachial valve. The low spreading fold is typical.
4. Brachial valve with nine plications on the lateral slopes.
Richmond group (Waynesville formation), Warren County, Ohio.

FIGS. 5–8. *Platystrophia acuminata* (James) p. 420.
5. Brachial valve showing the slightly elevated fold.
6. Brachial valve. The acuminate cardinal extreme are characteristic.
7. Pedicle valve. The plications on the slopes of the sinus have almost disappeared.
8. Posterior view of the shell.
Richmond group (Arnheim formation), Waynesville, Ohio.

FIGS. 9–12. *Platystrophia foerstei*, new species, p. 420.
9. Posterior view showing the long hinge-line.
Richmond Group Waynesville, Ohio.
10. Pedicle valve. The somewhat extended cardinal extremes are well illustrated.
Richmond group (Liberty beds), just east of Eastwood, Jefferson County, Kentucky.
11. Pedicle valve of a narrow specimen.
12. Brachial valve. The broad fold is typical.
Richmond group (Arnheim formation), 1 mile east of Seatonville, Kentucky.

FIGS. 13–16. *Platystrophia foerstei ampla*, new variety, p. 421.
13. Brachial valve of an average specimen.
Richmond group (Liberty), Ravine East of Floyd's Fork, Jefferson County, Kentucky.
14. Posterior view showing the ventricose form.
Richmond Group (Waynesville formation), Long Run near mouth of Tates Creek, Jefferson County, Kentucky.
15. Pedicle valve.
16. Brachial valve.
Richmond group (Waynesville), 1¼ miles southeast of Thixton, Jefferson County, Kentucky.

FIGS. 17–19. *Platystrophia elkhornensis*, new species p. 426.
17. Pedicle valve. The figure shows the strong growth varices.
18. Cardinal view showing the short hinge line and globose form.
19. Brachial valve.
Richmond group (Elkhorn Division), Elkhorn Creek, Richmond, Indiana.

FIGS. 20–24. *Platystrophia annieana* Foerste, p. 423.
20. Anterior view of a narrow specimen. The even convexity is characteristic.
Richmond group (Whitewater formation), Richmond, Indiana.
21. Pedicle valve. A mutation with five plications in the sinus.
22. Brachial valve of an average specimen.
23. Brachial valve. (Same specimen as fig. 21.)
Richmond group (Waynesville formation), Waynesville, Ohio.
24. Anterior view. This specimen has a higher fold than the average.
Richmond group, 1 mile east of Bradstown, Kentucky.

FIGS. 25–28. *Platystrophia moritura* Cumings, p. 424.
25. Brachial valve.
26. Anterior view showing the deep sinus.
Richmond group (Whitewater beds), Ripley County, Indiana.
27. Anterior view of a robust specimen. The slightly compressed fold is characteristic.
28. Pedicle valve. This figure represents a mutation with five plications in the sinus and six on the fold.
Richmond group (Liberty beds), railroad cut just northwest of Eastwood, Kentucky.

PLATE 47.

All figures on this plate are natural size.

FIGS. 1–11. *Platystrophia crassa* (James), p. 430.

1. Brachial valve.
2. Pedicle valve.
3. Lateral view. The gibbous form is typical.
4. Posterior view.
5. Pedicle valve of a short thick mutation.
6. Anterior view of a short thick mutation.
7. Anterior view of a specimen with a high fold bearing dwarfed lateral plications.
8. Pedicle valve of a high fold specimen.
9. Brachial valve. A specimen with a high fold bearing weak lateral plications.
10. Cardinal view of a short-hinged mutation.
11. Anterior view showing the deep sinus.

Maysville (Upper Fairmount), Cincinnati, Ohio; Covington, Kentucky.

FIG. 12. *Platystrophia crassa*, variety p. 432.

12. Brachial valve.

Richmond (Arnheim), 1½ miles south of Clark, Kentucky.

FIGS. 13–15. *Platystrophia pauciplicata* Cumings, p. 417.

13. Pedicle valve. The lateral slopes bear six plications.
14. Anterior view. Showing the thin valves.
15. Brachial valve. The fold is slightly elevated.

Maysville (Basal Fairmount), Covington, Kentucky.

FIGS. 16–18. *Platystrophia profundosulcata* (Meek), p. 429.

16. Brachial valve of a narrow specimen.
17. Pedicle valve showing the characteristic transverse form.
18. Anterior view. The profound sinus is typical.

Maysville (Basal Fairmount), Cincinnati, Ohio.

FIGS. 19–21. *Platystrophia profundosulcata hopensis* Foerste p. 430.

19. Pedicle valve showing the decidedly transverse form.
20. Brachial valve showing the prominent fold.
21. Anterior view.

Maysville (Mount Hope), Cincinnati, Ohio.

FIGS. 22–25. *Platystrophia cypha* James, p. 435.

22. Brachial valve showing the characteristic broad form.
23. Anterior view. The profound sinus is typical.
24. Pedicle valve which shows the extended hinge-line.

Richmond group (Arnheim formation), Waynesville, Ohio.

25. Anterior view showing the height of the fold. Richmond group (Arnheim formation), 1 mile east of Seatonville, Kentucky.

FIGS. 26–27. *Platystrophia cypha conradi* Foerste, p. 436.

26. Brachial valve.
27. Pedicle valve. The lateral plications of the fold are strong.

Richmond group (Arnheim formation), one-fourth mile northeast of Seatonville, Kentucky.

FIGS. 28–30. *Platystrophia cypha bellatula*, new variety, p. 438.

28. Brachial valve.
29. Anterior view.
30. Pedicle valve showing the characteristic narrow form.

Richmond group (Waynesville formation), Waynesville, Ohio.

PLATE 48.

All figures on this plate are natural size.

FIGS. 1–3. *Platystrophia cypha arcta*, new variety, p. 437.

1. Pedicle valve.
2. Anterior view showing the deep sinus.
3. Brachial valve. (Same specimen as fig. 2.) These figures show the characteristic narrow form.

Richmond group (Arnheim formation), Greenwell Ford Section, Bullitt County, Kentucky.

FIGS. 4–7. *Platystrophia unicostata* Cumings, p. 433.

4. Pedicle valve. The specimen has only two plications in the sinus.
Maysville group (Bellevue member), Madison, Indiana.
5. Cardinal view showing the somewhat extended cardinal extremes.
Maysville group, Southeastern Indiana.
6. Brachial valve. The high compressed fold bearing weak lateral plications is typical.
Maysville group, Lebanon, Kentucky.
7. Anterior view showing the characteristic profound sinus.
Corryville, Cincinnati, Ohio.

FIGS. 8–10. *Platystrophia unicostata crassiformis*, new variety, p. 434.

8. Anterior view. Showing the presence of one strong and two weak plications in the sinus.
9. Brachial valve. The high compressed fold is characteristic.
10. Pedicle valve.
These specimens show the typical narrow valves.
Mayesville group (Bellevue member), Madison, Indiana.

FIGS. 11–13. *Platystrophia laticosta* (Meek), p. 432.

11. Anterior view. The high fold and profound sinus are typical.
Maysville (Bellevue), Oldham County, Kentucky.
12. Pedicle valve.
13. Brachial valve showing weak plications on the slopes of the fold.
Maysville (Corryville beds), Cincinnati, Ohio.

FIGS. 14–16. *Platystrophia cypha*, variety.

14. Anterior view.
15. Pedicle valve.
16. Brachial valve.
Richmond group (Waynesville), Madison, Indiana.

FIGS. 17–20. *Platystrophia cypha tumida*, new variety, p. 436.

17. Brachial valve.
18. Pedicle valve.
19. Anterior view showing the great depth of the sinus.
20. Cardinal view. The tumid appearance is characteristic.
Richmond group (Arnheim formation), Southeastern Indiana.

PLATE 49.

All figures on this plate are natural size.

FIGS. 1–5. *Platystrophia ponderosa* Foerste, p. 427.

1. Cardinal view of an immature specimen.
3. Pedicle valve of an immature specimen.
5. Pedicle valve of a mature specimen.
Maysville group (Bellevue), Madison, Indiana.
2. Brachial valve of a specimen which is referred to this species.
Maysville group (Leipers formation), Leipers Creek, Tennessee.
4. Interior view of pedicle valve.
Maysville group, Oldham County, Kentucky.

FIGS. 6–8. *Platystrophia preponderosa*, new species, p. 427.
6. Pedicle valve. This figure shows a moderately deep sinus.
7. Brachial valve with a moderately elevated fold.
8. Cardinal view showing the globose form.
Trenton group (Catheys limestone), 2 miles west of Nashville, Tennessee.

FIGS. 9–12. *Platystrophia ponderosa auburnensis* Foerste, p. 428.
9. Cardinal view showing the shortened hinge-line and globose form.
10. Brachial valve. The well-marked growth lines are characteristic.
Maysville group (Mount Auburn), Cincinnati, Ohio.
11. Pedicle valve.
Maysville group (Mount Auburn) Oldham County, Kentucky.
12. Cardinal view of an immature specimen.
Maysville group (Mount Auburn), Madison, Indiana.

PLATE 50.

All figures on this plate are natural size.

FIGS. 1–3. *Platystrophia fernvalensis*, new species, p. 428.
1. Interior of pedicle valve showing the deep muscle scar.
2. Pedicle valve. The coarse plications at the beak split into striae as they approach the margins.
3. Brachial valve. The low fold is typical.
The outer margins of these specimens are broken away.
Richmond group (Fernvale limestone), Old Quarry southeast of Regenhardts Quarry at the northwest edge of Cape Girardeau, Missouri.

FIGS. 4–7. *Platystrophia ponderosa*, variety.
4. Cardinal view. The figure illustrates the short hinge and globose form.
5. Brachial valve showing curved plications next to the cardinal angles. (Same specimen as fig. 4.)
Richmond group (Arnheim formation), near Bakers, Tennessee.
6. Pedicle valve showing the broad round sinus.
Richmond group (Arnheim) east of Long Run Sta., Jefferson County, Ky.
7. Pedicle valve of a mutation with seven plications in the sinus.
Richmond group (Arnheim formation), Long Run, south of Eastwood, Kentucky.

This type of shell seems to be confined to the Arnheim member of the Richmond group.

FIGS. 8–11. *Platystrophia*, species.
8. Pedicle valve showing the broad shallow sinus.
9. Cardinal view. The extended hinge line is characteristic.
10. Brachial valve. The figure illustrates the low, broad fold.
11. Anterior view. The even convexity of the pedicle valve is shown.
Maysville group (Bellevue member), Madison, Indiana.
12. Cardinal view of a subquadrate mutation.
13. Brachial valve of the same specimen.
14. Pedicle valve of the same type of shell.
15. Lateral view of the same specimen.
Maysville group (Mount Auburn), Cincinnati, Ohio.

PLATE 51.

FIGS. 1–5. *Platystrophia ponderosa*, variety.
1. Brachial valve showing the loss of slope on the left side of fold.
Richmond group (Arnheim formation), on Floyd's Fork, 1 mile northeast of Seatonville, Kentucky.
2. Brachial valve of a decidedly asymmetrical form.

FIG. 3. Brachial valve in which the differentiation between the fold and right slope is lost.

4. Pedicle valve of the same specimen.
Richmond group (Arnheim formation), Brush Run, 1 mile east of Seatonville, Kentucky.

5. Brachial valve of a specimen in which the fold is asymmetrical.
Richmond group (Arnheim formation), one-fourth mile east of Fisherville, Kentucky.

FIGS. 6–8. *Platystrophia ponderosa arnheimensis*, new variety, p. 428.

6. Anterior view. The thick valves and coarse pliations are characteristic.
Richmond group (Arnheim formation), 1½ miles west of Clark, Kentucky.

7. Pedicle valve of a mutation with four plications in the sinus.
Richmond group (Arnheim formation), Brush Run, 1 mile east of Seatonville, Kentucky.

8. Brachial valve of a specimen with a short hinge.
Richmond group (Arnheim formation), Long Run, three-fourths mile above Boston, Kentucky.

PLATE 52.

All figures on this plate are natural size.

FIGS. 1–3. *Platystrophia ponderosa*, variety.

1. Brachial valve of a mutation with five plications on the fold.
2. Cardinal view.
3. Pedicle valve. (Same specimen as fig. 1.) The illustration shows four plications in the sinus.
This variety is characterized by its transverse form.
Richmond group (Arnheim formation), one-fourth mile east of Fisherville, Kentucky.

FIGS. 4–6. *Platystrophia*, species.

4. Cardinal view.
6. Pedicle valve. This variety has a broad shallow sinus and acuminate hinge extremes.
This form has many characters in common with those illustrated in plate 50, figs. 5, 8–11.
Richmond group (Arnheim formation), 1 mile east of Seatonville, Kentucky, on Floyd's Fork.

5. Brachial valve showing the low rounded fold.
Richmond group, Lebanon, Ohio.

FIGS. 7. *Platystrophia ponderosa* Foerste.
Interior view showing the deep muscle scars and the articulation.
Maysville group (Bellevue member), Madison, Indiana.

FIGS. 8–9. *Platystrophia ponderosa*, variety.

8. Anterior view of a similar specimen.
Richmond group (Arnheim formation), 1 mile east of Seatonville, Kentucky.

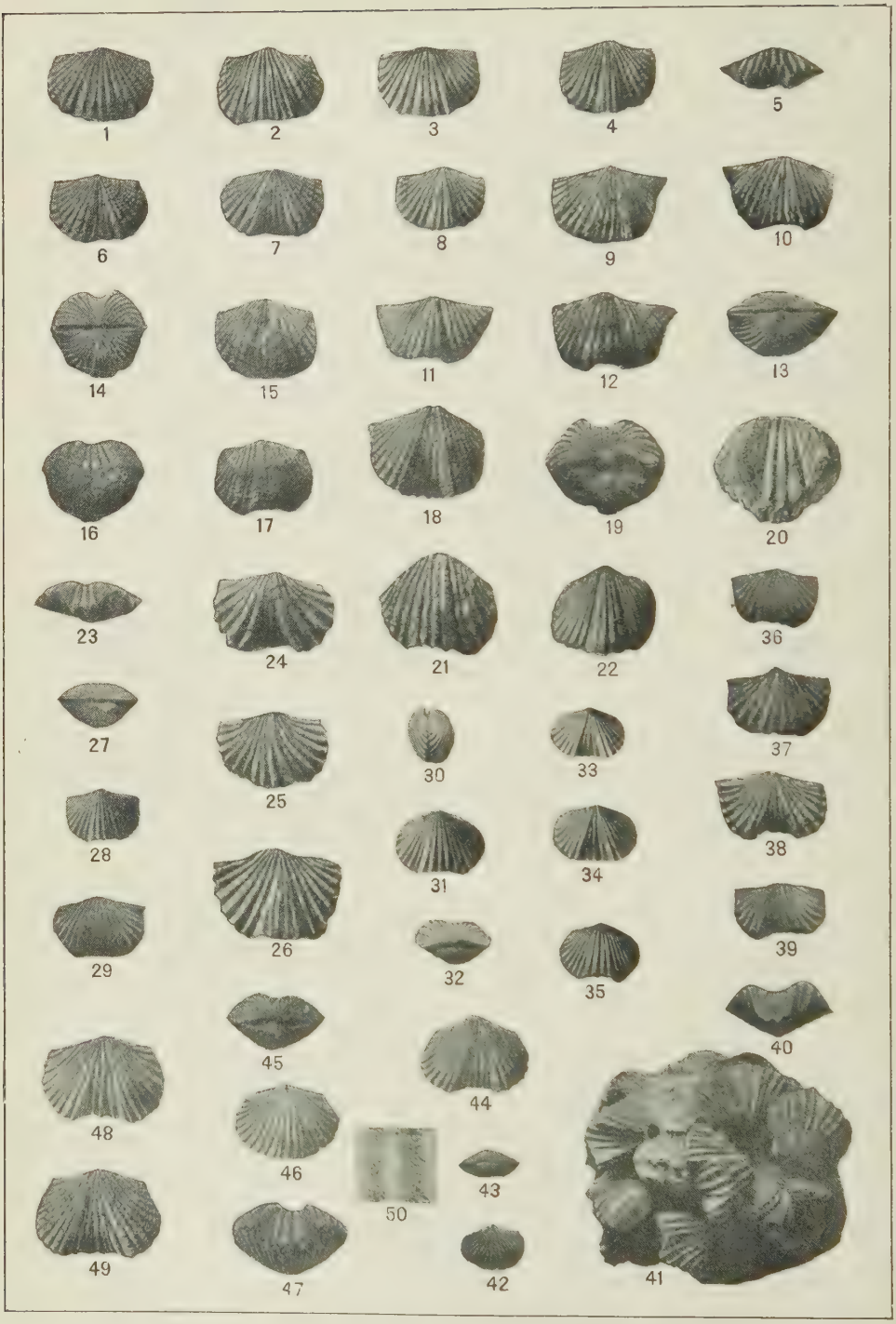
9. Brachial valve of a mutation with seven plications on the fold.
Richmond group, 4 miles northeast of Gallatin, Tennessee.

FIG. 10. *Platystrophia ponderosa* Foerste.

10. Interior view of the brachial valve, *c.* cardinal area; *cp.* cardinal process; *d.* delthyrium; *m.* muscle scar; *s.* septum; *t.* teeth.
Maysville group: Cincinnati, Ohio.

THE BRACHIOPOD GENUS PLATYSTROPHIA

FOR EXPLANATION OF PLATE SEE PAGES 438, 439, AND 440



THE BRACHIOPOD GENUS PLATYSTROPHIA

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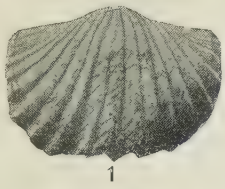
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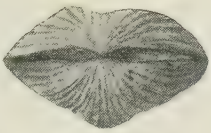
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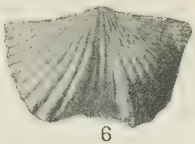
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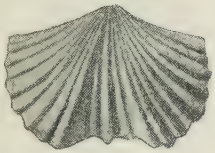
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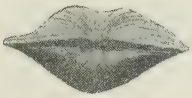
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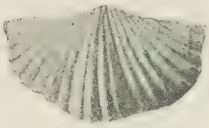
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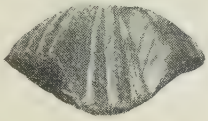
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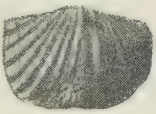
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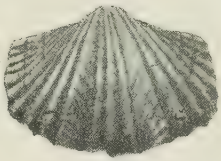
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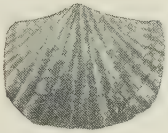
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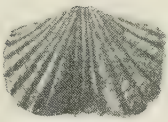
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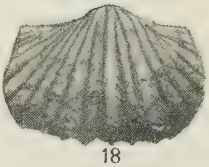
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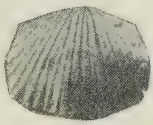
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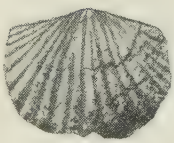
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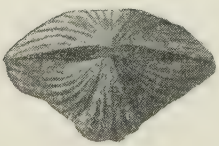
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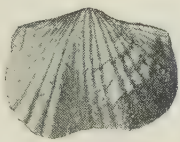
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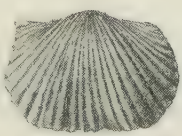
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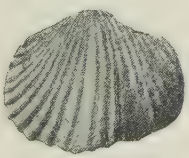
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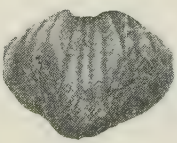
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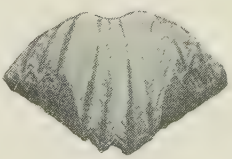
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THE BRACHIOPOD GENUS PLATYSTROPHIA

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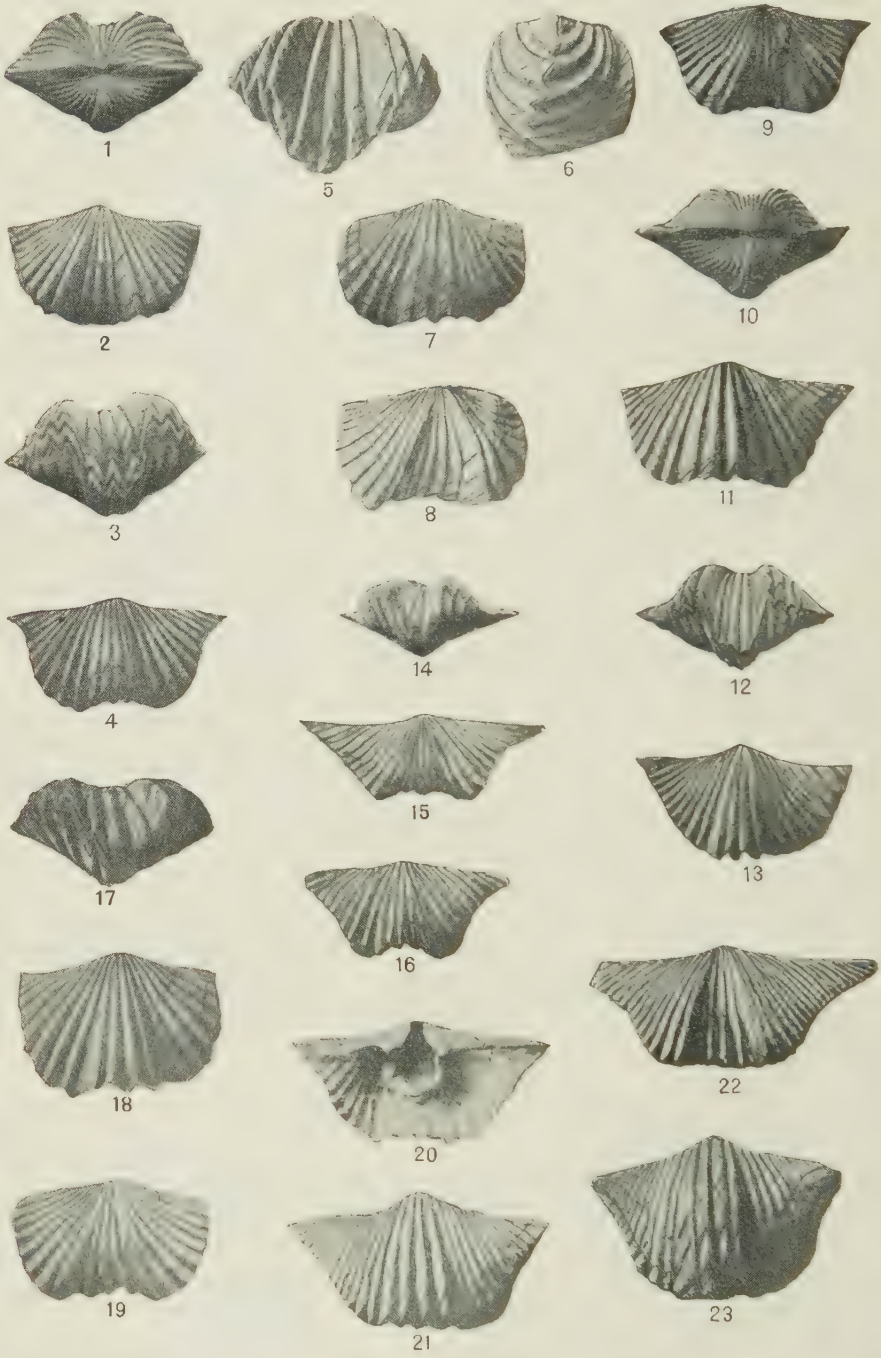

THE BRACHIOPOD GENUS PLATYSTROPHIA

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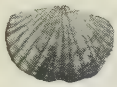
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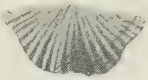
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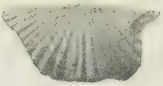
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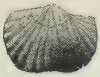
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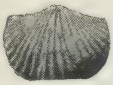
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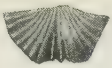
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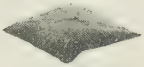
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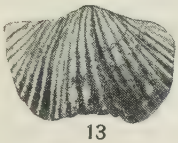
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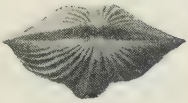
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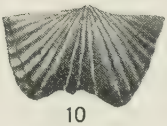
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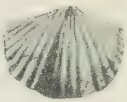
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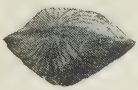
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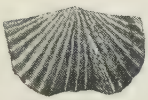
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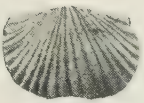
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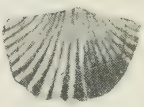
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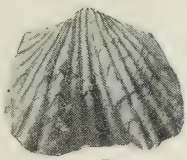
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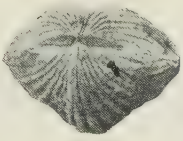
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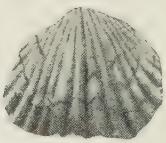
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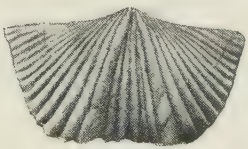
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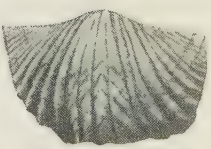
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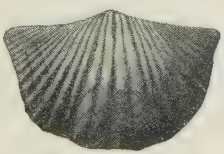
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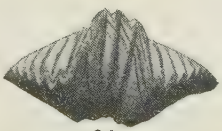
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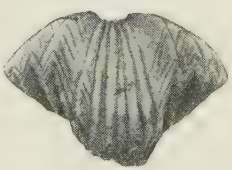
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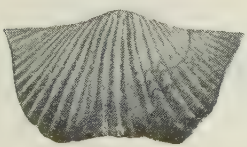
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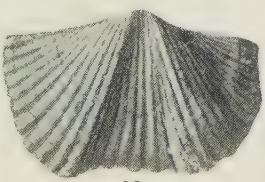
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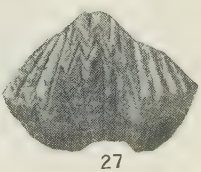
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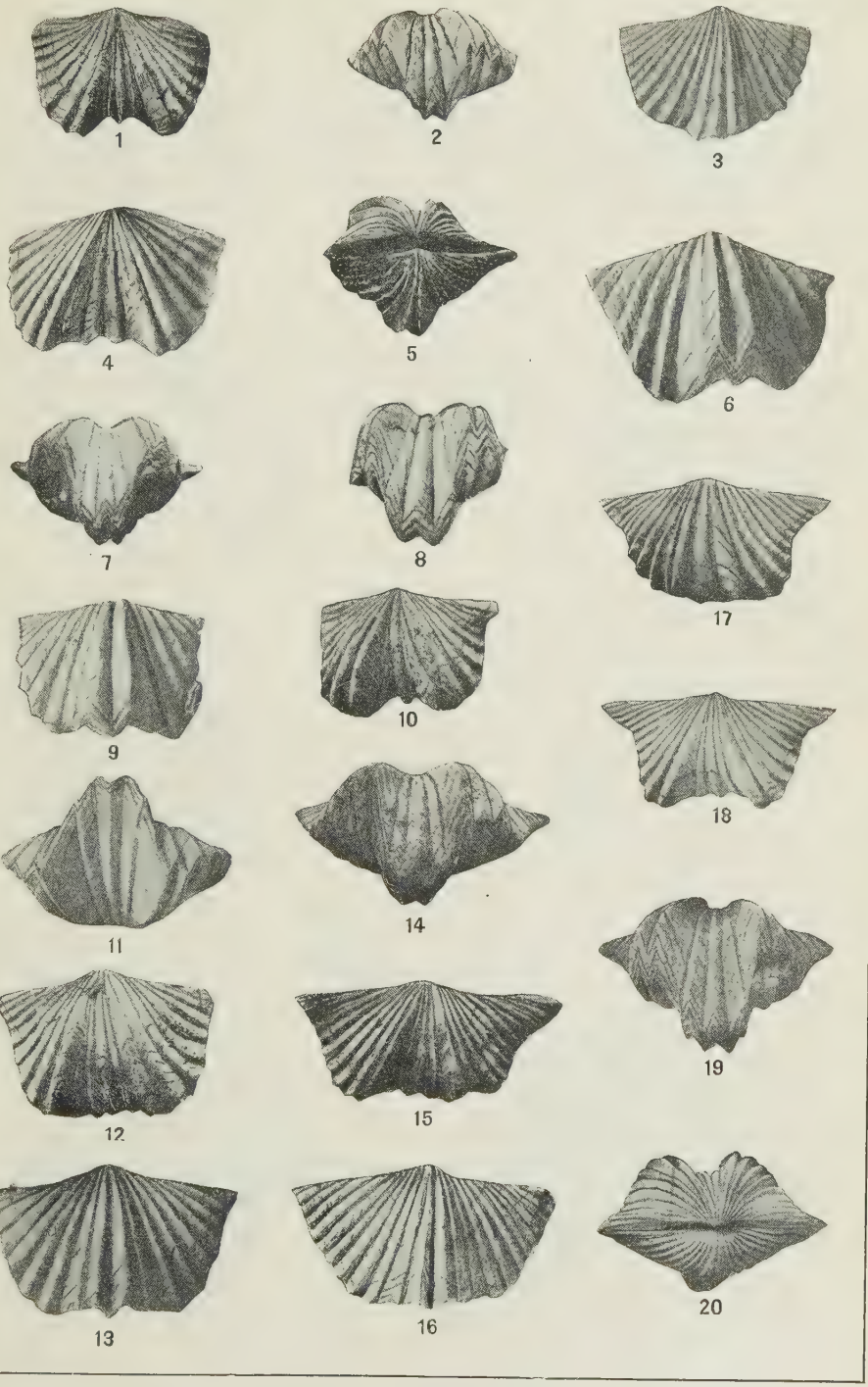
THE BRACHIOPOD GENUS PLATYSTROPHIA

FOR EXPLANATION OF PLATE SEE PAGES 443 AND 444

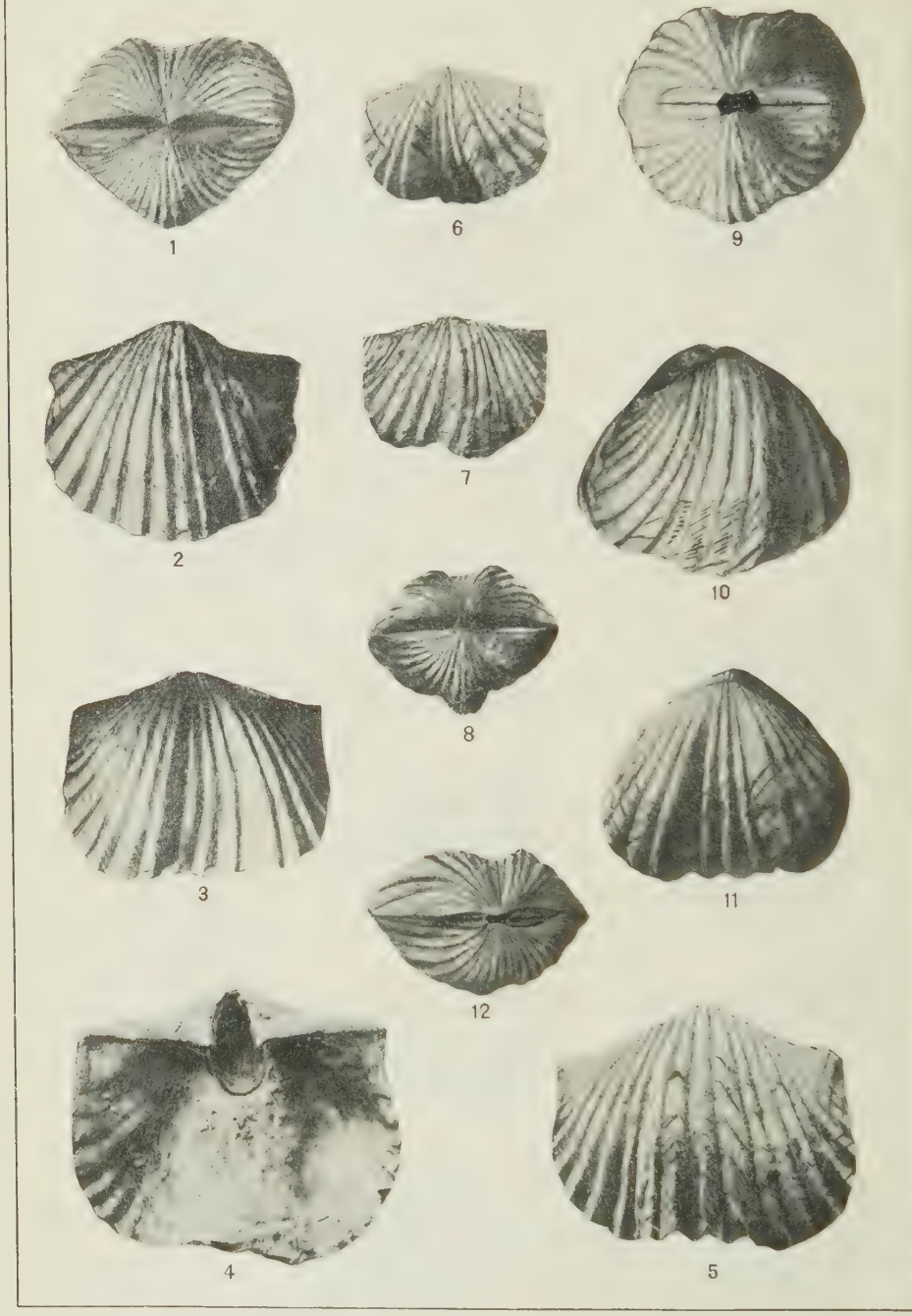
THE BRACHIOPOD GENUS PLATYSTROPHIA

FOR EXPLANATION OF PLATE SEE PAGE 445



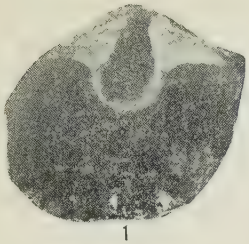
THE BRACHIOPOD GENUS PLATYSTROPHIA

FOR EXPLANATION OF PLATE SEE PAGE 446



THE BRACHIOPOD GENUS PLATYSTROPHIA

FOR EXPLANATION OF PLATE SEE PAGES 446 AND 447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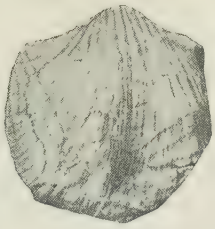
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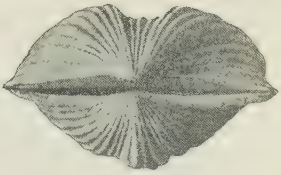
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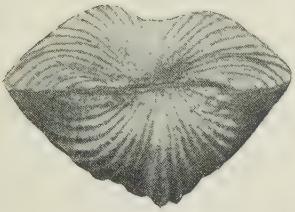
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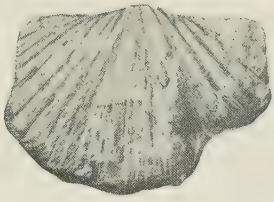
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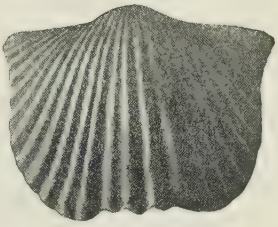
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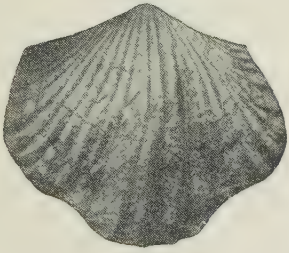
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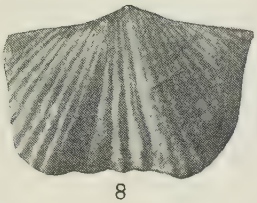
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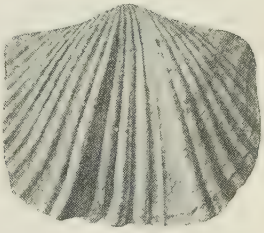
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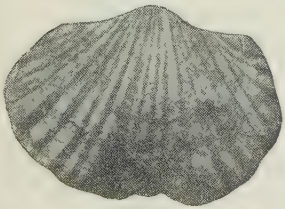
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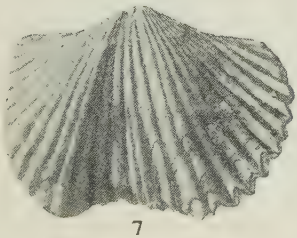
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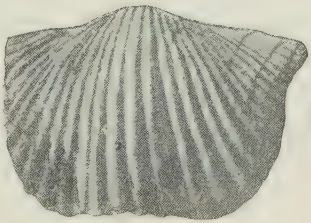
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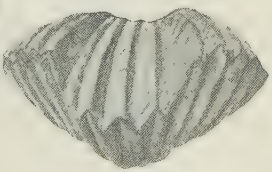
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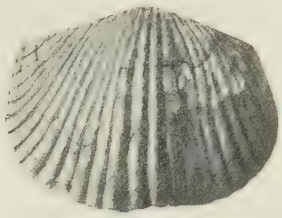
THE BRACHIOPOD GENUS PLATYSTROPHIA

FOR EXPLANATION OF PLATE SEE PAGE 447



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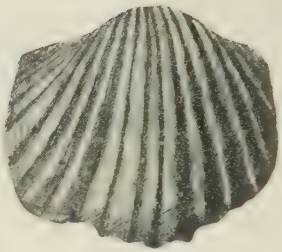

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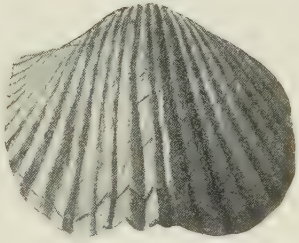

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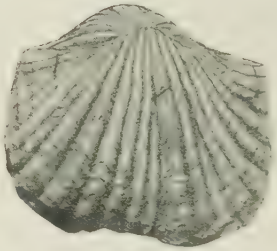

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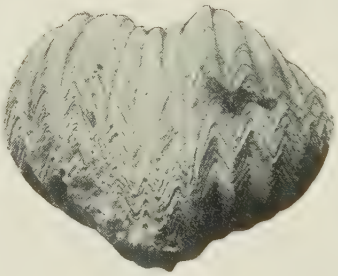

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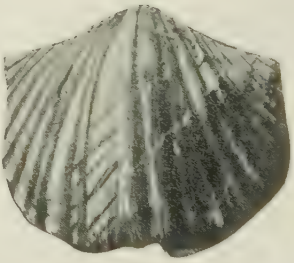

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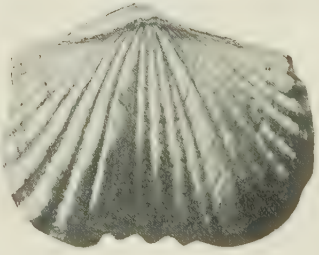

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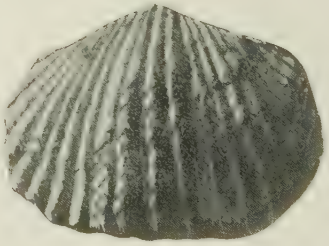

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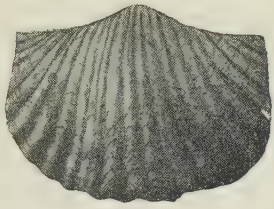
THE BRACHIOPOD GENUS PLATYSTROPHIA

FOR EXPLANATION OF PLATE SEE PAGES 447 AND 448



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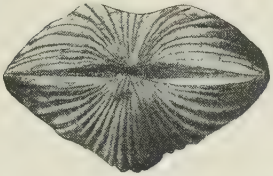

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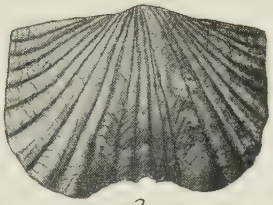

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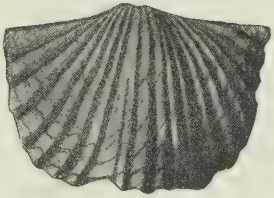

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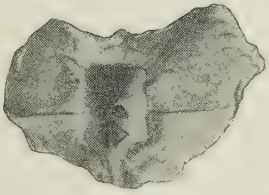

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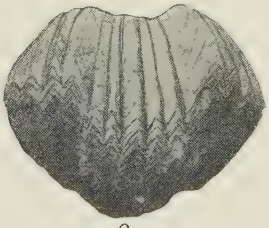

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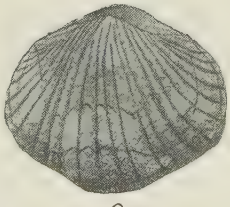

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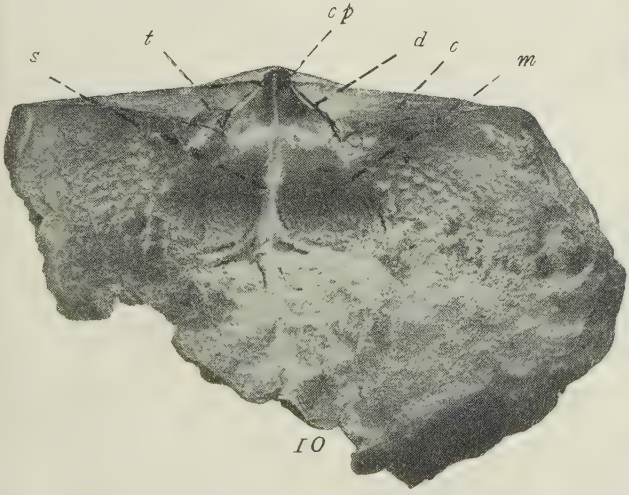


10

THE BRACHIOPOD GENUS PLATYSTROPHIA

FOR EXPLANATION OF PLATE SEE PAGE 448

HABITS AND ECONOMIC RELATIONS OF THE GUANO BIRDS OF PERU.

By Robert E. Coker,

In charge Scientific Inquiry, United States Bureau of Fisheries.

INTRODUCTION.

In the course of an economic study of the guano and fishery industries undertaken for the Peruvian Government and carried on from December, 1906, to August, 1908, I enjoyed many opportunities for observing the habits and determining the commercial importance of birds frequenting the guano islands or their environments. On several occasions I was enabled to live in camp upon the islands during the season when they were by law closed to the general public, although on such favorable occasions it was never possible to give exclusive attention to studies of the birds.

After making the necessary reports with recommendations to the Government of Peru,[1] I returned to the United States with a body of uncompiled field notes, as well as with a considerable collection of specimens representing the fauna and flora of the coastal waters, and some specimens of the sea birds. The collections, excepting the birds and some miscellaneous specimens, have been reported upon by specialists in the several groups.[2] A general account of the guano

[1] Several papers in the Boletin del Ministerio de Fomento, published in Lima, 1907–1909. See also Regarding the future of the guano industry and the guano-producing birds of Peru. Science, N. S. vol. 28, No. 706, pp. 58–64. July 10, 1908.

[2] Howe, Marshall Avery: The marine algae of Peru, Mem. Torrey Bot. Club, vol. 15, pp. 1–185, 66 plates and 44 text figures. New York, Sept. 19, 1914.

Clark, Hubert Lyman: The echinoderms of Peru. Bull. Mus. Comp. Zool., at Harvard College, vol. 3, pp. 1–358, 14 pls. Cambridge, Mass., Oct., 1910.

Dall, William Healy: Report on a collection of shells from Peru, with a summary of the littoral marine mollusca of the Peruvian Zoological Province. Proc. U. S. Nat. Mus., vol. 37, pp. 147–294, with pls. 20–28. Washington, Nov. 24, 1909.

Pillsbry, Henry A.: Report on barnacles of Peru, collected by Dr. R. E. Coker and others. Proc. U. S. Nat. Mus., vol. 37, pp. 63–74, with pls. 16–19. Washington, Oct. 18, 1909.

Richardson, Harriet: Report on isopods from Peru, collected by Dr. R. E. Coker. Proc. U. S. Nat. Mus., vol. 38, pp. 79–85. Washington, May 3, 1910.

Walker, Alfred O.: Marine amphipods from Peru. Proc. U. S. Nat. Mus., vol. 38, pp. 621–622. Washington, Oct. 18, 1910.

Weckel, Ada L.: Fresh-water amphipods from Peru. Proc. U. S. Nat. Mus., vol. 38, pp. 623–624. Washington. Oct. 18, 1910.

Rathbun, Mary J.: The stalk-eyed crustacea of Peru and the adjacent coast. Proc. U. S. Nat. Mus., vol. 38, pp. 531–620, with pls. 36–56. Washington, Oct. 20, 1910.

Evermann, Barton Warren, and Lewis Radcliffe: The fishes of the west coast of Peru and the Titicaca Basin. U. S. Nat. Mus. Bull. 95, pp. 3–157, with pls. 1–14. Washington, 1917.

and fishery industries appeared in the Proceedings of the Fourth International Congress meeting in Washington in 1908.[1] Various circumstances unnecessary to be detailed in this place combined to delay, first, the compilation of the observations relating to the habits of the birds, and, second, the publication of the manuscript after it was completed. During the past few years other investigators have studied the guano industry, but, so far as the writer is aware, no report has been issued to cover the ground of the present paper.[2] Its publication even at this time seems therefore desirable.

It does not seem inappropriate to indicate briefly, or at least to suggest, some of the conditions under which the studies were pursued, for, had more favorable circumstances prevailed, investigations covering a period of like duration might have been productive of more extensive and valuable results.

Travel was sometimes accomplished by taking a steamer from one port to another, whence small sailing skiffs were used to visit islands that were 10 to 50 miles from port and upon which temporary camps could be established if desired. At other times trips of 100 to 500 miles were made in a balandra, or small cargo sloop. In a few instances travel could most conveniently be made by pack over the desert.

As one may have inferred, the studies were primarily economic and directed at two related industries.[3] In such a case the primary needs could be met only by securing accurate knowledge of the natural forms upon which the industries are based and recording the methods of operation as well as the precise conditions under which they were conducted. With only unskilled assistance available, it was necessary for the investigator to devote much time personally to the collection and preservation of specimens, to the inevitable routine of record keeping, and to the preparation of reports describing the existing commercial operations.

It will be understood that the conditions both of work and of travel were not favorable to the preservation of so many skins of birds as it would have been desirable to save. I am glad, however, to acknowledge the cordial aid rendered by Mr. Robert Gunner, of Callao, who, having started with me as interpreter, acquired some facility in the preparation of bird skins and in other services. In all, about 80 skins were saved and 30 lots of eggs. With the permission of the Peruvian Government, and by its direction, this small col-

[1] Coker, R. E.: The fisheries and the guano industry of Peru. Bulletin of the Bureau of Fisheries for 1908, vol.28, Washington, pp. 333–365, pls. 12–17, 1910.

[2] Allusion must be made, however, to two interesting papers by Prof. Henry O. Forbes, which will be cited and quoted in a proper connection on a later page.

[3] Peruvian guano is indirectly but obviously a product of fish. The birds in this case fulfil a function comparable to that of the American factories that convert fish into fertilizer. The operation of the birds may in some respects be relatively wasteful, but the product yielded by them has the virtue of being in a form more readily available to the growing crops.

lection was divided between the National School of Agriculture of Peru and the United States National Museum.

The specimens transmitted to the National Museum were identified by Dr. Charles W. Richmond, to whom grateful acknowledgment is made. All specimens were provisionally identified in the field, with the aid principally of Taczanowski's invaluable Ornithologie du Pérou.[1] It was found that few errors had been made in field identifications and that these did not apply to any of the important species. Accordingly, the observational data is of correct application to the several species treated.

I can not fail to express my strong sense of indebtedness to Señor Don Carlos Larrabure y Correa, then Director de Fomento, who, with sympathy, wisdom, and energy, facilitated my investigations in every way possible. Mr. Edmundo de Habich, at that time chief of the division of agriculture, extended me many courtesies and valuable assistance. To Capt. Chase, manager of the Callao house of Messrs. W. R. Grace & Co., and to Mr. H. H. Bunting, chemist of the Peruvian Corporation, I was sensibly indebted for counsel and suggestions. Finally, I may with full propriety acknowledge the invaluable encouragement derived from a knowledge of the direct and personal interest maintained throughout the investigations by Señor Don Manuel Pardo, at that time President of the Republic of Peru, and by Señor Don Augusto B. Leguia, then minister of the treasury and subsequently President, both of whom gave effect to some of the recommendations offered in course of the study.

The following pages deal more particularly with the habits and significance of birds that were observed to possess economic importance, but they comprise also some account of other species which are associated with the useful birds as enemies or as competitors, and such additional data as are essential for an understanding of the conditions of life of the birds and their economic significance.

GENERAL FEATURES OF THE COAST.

From Paita, at 5° south latitude, to the southernmost limits of present Peruvian territory, a distance corresponding to that between New York and Cuba, or about 1,300 miles, the coast of Peru and the waters bathing its shores are characterized by conditions of remarkable uniformity. Striking physical features, and significant as affecting both aquatic and avian fauna, are the bold and rocky shores, the absence of large islands, the moderate but almost invariable southwest trade winds, the low humidity and the relatively and unvaryingly cold sea water.

[1] Taczanowski, Ladislas. Ornithologie du Pérou, vols. 1–3, and a volume of tables (key and index). Rennes. 1884–1886.

As is well known, the continental shelf bordering the coast of Peru is very narrow and the sea bottom declines from the shore so precipitately as to leave few bays or harbors and no really large islands. The cold Humboldt current, with its steadily and visibly flowing waters, is thus brought so close to the mainland shore as to preclude the occurrence of warm seas or the development of typically "tropical" conditions.

The temperatures of the surface waters have been treated in a separate paper.[1] It may be sufficient here to say that surface temperatures as low as 17° C. (63° F.) were noted in the bay of Paita (5° S.) in midsummer, while a temperature of 16° prevailed at Mollendo (17° S.) in midwinter. Excluding observations in protected waters, the observed range of temperature in any locality did not exceed 3.4° C. and was usually 1° to 1.5° C. The air temperatures exhibit some variation, but, about the islands, at least, they are so generally governed by the water as to make the seasonal changes relatively small. That such uniformity of temperature conditions may have a marked influence upon the breeding habits and breeding seasons of the birds is to be inferred, and in the following pages, in reference to several species of birds, there will be noted a tendency to prolong the breeding season, if not to extend it over the entire year.

Since breezes from a cool sea must pass over lands that are warmed under a tropical sun, no opportunity for precipitation occurs and neither rainy seasons nor occasional rains may prevail. It is true that in the very northern portion of Peru heavy rains may occur at intervals of years, and at no great distance from the coast, and that the mainland coast generally becomes sufficiently cooled in winter to suffer a settled condition of fog and mist, or garua; but the several islands a little offshore are, absolutely or practically, free from rainfall, and conditions of atmospheric moisture sufficient to permit of the growth of ordinary vegetation can be found only upon the high peaks which are wrapped with clouds. The most interesting and economically significant consequence of the arid climate is that the nitrogen of the guano deposited by the birds can not become converted into ammonia to be lost by evaporation, but is permanently preserved in a form readily available for the purposes of agriculture. The absence of rains and storms must have no little effect, too, upon the abundance of available food and upon the successful propagation of the birds.

Notwithstanding the general correctness of the preceding statements, a distinct difference may be noted in the atmospheric conditions prevailing over the northern islands. Nearer the equator and the upper limit of the Humboldt current the sea breeze comes some-

[1] Coker, R. E. Ocean temperatures off the coast of Peru. The Geographical Review, vol. 5, New York, February, 1918, pp. 127–135.

what warmer and more moisture-laden, and it is undoubtedly true that at rare intervals the northern current has reached at least as far south as the Lobos Islands. Light rains are not unknown at Lobos de Tierra (6.5° south), and this doubtless accounts for the presence of certain very small patches of vegetation and for the inferior quality of the guano.

With conditions so uniform along the coast, it is evident that at one time or another birds may have occupied rookeries at thousands of different places on mainland or island, and breeding places, even of the distant past, would be marked by the accumulation of guano. Hundreds of places have, in fact, been the seat of commercial operations in the extraction of guano. Chief in historical importance are the Chincha and Ballestas Islands, the islands of Guañape and Macabi, and the larger Lobos Islands, de Afuera and de Tierra. Pabellon de Pica was an important point at one time, but it has passed from the jurisdiction of Peru and was not, therefore, included in the field of my observations. Many places of secondary importance might be mentioned, such as the Islas Santas, Palominos, Fronton, Asia, Santa Rosas, Vieja, and Cerro Azul.

The writer visited all of the islands of importance except the Islas Santas, northward from Chimbote. A list of these points, with the approximate latitudes, is given in an appendix. There were scarcely any noteworthy breeding places on the mainland at the time of my visit, so that the scenes of observation were principally upon the islands.

CHARACTER OF THE PERUVIAN ISLANDS.[1]

None of the islands are very large or far removed from the coast. One of the nearest islets (Isla Lobería, near Cerro Azul) is so close to the main shore as to be conveniently reached by an aerial trolley, while most of the islands are not more than 10 or 12 miles removed. The single group at all remote is the Lobos de Afuera, which is about 33 nautical miles from the nearest point of mainland. The largest island is that of Lobos de Tierra, with its length of nearly 6 miles and a width varying from one-sixth of a mile to 2 miles. The Lobos de Afuera Islands combined are slightly smaller, while each of the two larger Chincha Islands will not average a half-mile in diameter. The south (and smallest) island of the Chincha group, and recently the most important, has an extent of less than 30 acres, the greater part of which was covered by the nests of birds. The islands of Ballestas, a sister group of the Chinchas, and, like it, composed of three principal units, are approximately equal to the smallest of the Chinchas. They are bolder and higher and must be gained by climbing from

[1] For mention of practically every island and detailed description of certain features of the coast of Peru, see Rosendo Melo's admirable "Derrotero de la Costa del Perú," pp. XLVIII, 302.

the water, being without beaches except at the bases of unscalable cliffs. These islands of Ballestas are from 100 to 300 feet in height.

All of the islands are more or less bold, rocky, and barren. The rocky nature of the ground and the general presence of too strongly concentrated fertilizer, as well as the want of atmospheric moisture, would seem to preclude the possibility of plant growth. At any rate, vegetation of any kind is entirely absent, except where the higher points reach such an altitude (about 1,200 feet) as to derive moisture from the clouds; the higher peaks may, therefore, support luxuriant but entirely isolated gardens of vegetation. This occurs only on such lofty islands as San Gallan, La Isla Vieja, and San Lorenzo.

Naturally, on such barren islands, when the ultimate source of food is in the sea, the fauna is very restricted. Besides the birds and sea-lions, we find only parasitic insects, and their enemies, the spiders, scorpions, lizards, and bats;[1] except that, on the verdure-clad peaks just mentioned, colonies of land snails have in some way been introduced, perhaps by the condors which visit back and forth from mainland to island. Escaped cats live freely on Lobos de Afuera. I observed an otter in the water near the beach of San Gallan, and also captured a specimen of cricket on the beach of the same island.[2]

There are certain islands for which the birds show a predilection, and some of these appear to have been favored breeding places for centuries. Particular islands appeal to the fancy of certain birds, so that for each island or group of islands there may be a particular bird claiming "eminent domain." As instances, there may be cited the possession of the South Chincha and the Ballestas Islands by the white-breast cormorant, San Gallan by a diving petrel, one of the Santa Rosas Islands by the little tern (*S. hirundinacea*) and the Lobos Islands by the pelican, and the larger gannet. Off-lying islets may be taken by another species than the one occurring in principal abundance on the main island. Thus, in the realm of the cormorants at the Chinchas, a small rookery of pelicans occupied the flat top of an islet near the north island; while just across from the pelican rookery on Lobos de Tierra, a low islet was crowned with cormorants.

Briefly to indicate the economic significance of the guano birds, it may be recalled that a quantity of more than 10,000,000 tons of high grade guano is reported to have been extracted from the Chincha Islands between 1851 and 1872. Such an amount of guano of the high grades then exclusively used would have a pre-war value of

[1] Examples of lizards and bats collected by the writer on the guano islands and deposited in the United States National Museum were identified as follows: *Phyllodactylus gerrhopygus* (Wiegmann), lizard from San Gallan Island, near the beach. *Phyllodactylus inequalis* Cope, lizard from Lobos de Afuera Island, near the beach. *Tropidurus peruvianus* (Lesson), lizards from Lobos de Tierra, near the beach, and from Chincha North Island. *Desmodus rotundus rotundus* (Geoffroy), bat from cavern in one of the Ballestas Islands.

[2] The description of the islands is taken in part from an unpublished manuscript of the writer, which is in the hands of the National Geographic Society.

about three quarters of a billion dollars. Billion-dollar birds, they have easily been without exaggeration. Well before the close of the century the best ancient deposits were exhausted and the lowest grades were being sought. In the first years of the present century the exportation was in the neighborhood of 100,000 tons a year. At the present time it is less. The requirement of Peruvian agriculture as estimated in 1905 was 25,000 to 40,000 tons a year. While the the remnants of the ancient deposits, so far as is known, are of the lowest quality (3 per cent or less of nitrogen), it is to be emphasized that the annual production of the birds, amounting in 1906-1908 to 20,000 tons or more, is of the highest grade, yielding by analysis from 12 to 17 per cent of nitrogen (with higher ammonia equivalent)

THE PENGUIN.

One of the most interesting birds of the Peruvian coast is the smaller penguin, *Spheniscus humboldti* Meyen (pl. 53, fig. 1). The Peruvians aptly call it the "pajaro-nino," or "baby-bird." Observed from a distance, the waddling uncertain gait and the stumpy flightless wings held out awkwardly inevitably suggest the manner of an infant toddling on the beach.

Undoubtedly the penguin was much more abundant on the coast many years ago than it is at the present. Raimondi,[1] at the time of his visit (evidently in 1855), mentioned that the penguin had quite abruptly left the north island of the Chinchas, was rarely found in the middle island, but was in "great abundance" on the south island at that time. This change of home was undoubtedly due to the operations of guano extraction that were being carried on upon the islands. At the present time a few penguins may be observed at any of these islands, but nowhere could they be described as abundant. The largest number seen at one time was on the beach of the Isla Vieja, in the Bay of Independencia, where about 60 birds were congregated.

The northward range of the penguin is surprising at first, but it is readily accounted for by the effect of the cold Humboldt Current, which, supplemented as it doubtless is by the upwelling of bottom waters, tempers the climate of the coast of Peru, even up to within a few miles of the equator. The farthest north I observed the penguin was at the islands of Lobos de Afuera in 7 degrees South latitude. At Guañape very young penguins were seen on the rocky shore in March, 1907, or late summer of the southern hemisphere. At the Ballestas Islands, a part of the Chinchas group, in May, 1907, the nests of the penguin were found commonly in some of the deeper caverns. Most of the nests contained eggs, some of which were just hatching; a month later a number of grown but immature

[1] Raimondi, A. Mémoire sur le huano des îsles de Chincha et les oiseaux qui le produisent. (Extrait.) Compt. Rend. Acad. Sci., vol. 42, 1856, pp. 735–738. Paris. 1856.

birds were seen at the Bay of Independencia. These observations would suggest that the breeding season extends over the greater part of the year, since we find young penguins in late summer and eggs and immature young in early and midwinter. Two mature males that I killed were, respectively, 67 and 72 cm. long, 47 and 48 cm. in girth, and 9¾ and 11⅛ pounds in weight.

Raimondi (1856) [1] makes the following interesting note regarding Spheniscus, which not only testifies to the much greater abundance of the penguin in past time, but comprises a valuable observation concerning their breeding places at a time when the caverns could not have afforded sufficient space for them.

> The Spheniscus are abundant on the south island [Chincha group], which as I have said, was uninhabited [by guano workers]. It is probable that they have been driven from the north island by the ships that repair to that place in great numbers, and by the exploitation works. These birds, not being able to fly, seek shelter and dig for themselves a subterranean home in the guano itself.
>
> At the season when I visited the islands [evidently September, 1855] they were occupied in incubating their eggs which are of the size of an egg of a turkey, and from two to four in number [p. 738 translated].

It was at the small islands of Ballestas, a sister group to the Chinchas, that I had the best opportunity to see the penguin. The bluff faces of these islands are marked by many caverns, some of which extend deep into the islands beneath the high table-like tops. The north island of the group is practically undermined on all sides by such caves. Rowing around this island we could see a number of penguins in couples or small groups in numerous hollows and small caves or "cuevacitas." Far back in one of the large caves a considerable number of these birds were conspicuous, even in the obscurity of that deep vault, for their glossy white breasts and lateral stripes. The stripes of the sides and backs were generally better marks than the breasts, since the latter, though naturally white, were often quite dark with the mud and manure of the nests. Directing our boat into one of these caverns we rowed up well under one of the great arches forming the double entrance, but were obliged to put back as the boatmen were afraid of being unable to handle their craft in the swell and among the rocks. Another cavern proved more feasible of approach; after being rowed back to where the water was quite shallow near the beach at the inner end, I could step into the water and wade ashore. Some of the penguins ran hurriedly into the water along the sides, while about a dozen retreated to the very back of the cave. As soon as the eye became accustomed to the darkness, fully a dozen nests could be seen, each with two large eggs. The nests were simply hollows in the larger rocks and covered with bones, evidently those of penguins.

[1] Raimondi, A. Mémoire sur le huano des isles de Chincha et les oiseaux qui le produisent. (Extrait.) Compt. Rend. Acad. Sci., vol. 42, 1856, pp. 735–738. Paris. 1856.

The penguins are active indeed for walking birds and step along with quickly moving feet, but with an awkward movement of the upper part of the body, and with wings hanging out like stiff and useless little arms. When they have retreated to the back of their cavern they make no further effort to run out and escape, but huddle together and gaze stupidly at the intruder. They make a queer twisting movement with the head and neck so as to place first one side of the head toward you then the other, pausing a moment between each twist. When the natives capture them they do so by striking them on the back of the head with a club or with a stone thrown at them, for their bills are too strong and vicious in defense to make a close approach entirely safe. Once it is slightly stunned, a penguin may safely be taken up by the back of the neck. Even after an extremely severe blow they soon recover and appear to be in good health.

We kept a penguin at our camp for some weeks restrained by a long line (pl. 53, fig. 1). When it rested upon the rocks above the water, its round fat body and stout neck laid flat on the rock, its slick hair-like covering of short close feathers, and its outspread seal-like flippers, all gave it the semblance of a dimunitive sea lion. Penguins are strong swimmers and, when free in nature, dive for considerable distances, coming up only for a moment's breathing and each time indicating their position by a peculiar cry, a slightly prolonged hoarse note of a single pitch, much like the sound of a toy trumpet. At night they are frequently heard to bray in such close imitation of the donkey, that one might well be deceived except for the knowledge that the vicinity is that of a desert island.

The penguins yield a guano which is generally esteemed, and is regularly sought, but, because of the greatly reduced abundance of the birds and the conditions surrounding the nests in the deep, damp caverns, the fertilizer derived from the penguins is deficient now both in quantity and quality. The birds are frequently killed by the fishermen or guano workers, who esteem not only the oils derivable from them, but the skins which are well adapted for the making of warm "fur" caps.

THE GULLS AND TERNS.

The most common gulls of the Peruvian coast are the large white "gaviota," "cleo," or "cau-cau," *Larus dominicanus* Lichtenstein, a smaller white "gaviota" or "simeón," *Larus belcheri* Vigors, and the slate-colored "matéo," *Larus modestus* Tschudi. The matéo was generally observed south of Callao. The two gaviotas are so much alike in color that the two species are readily confused at a distance. At closer view, *L. belcheri* is easily distinguished by its smaller size, its red-tipped bill, and bright yellow feet and tarsi; the feathers of

the back are pearly white, and not *pure* white as in the larger species. As I observed it this species was wilder, being found more commonly about outlying rocks, while the *dominicanus* is the familiar visitant of the beaches and fishing camps. The following notes refer to *Larus dominicanus*.

LARUS DOMINICANUS Lichtenstein.

THE GAVIOTA.

The gaviota, or Dominican gull, is so generally distributed over southern seas and so familiar to travelers and seamen that one hesitates to imagine that the observations of any but the most experienced ornithologist could add to existing knowledge regarding it. Nevertheless, to exclude the gaviota from the present account would be to leave the picture of bird-life upon the islands too incomplete, and to ignore a most significant element in the bionomics of the bird communities.

Though not equaling most of the other birds of the islands in abundance, value, or interest, the gaviotas form an important element in the aesthetic effect and keep one most insistently reminded of their presence (pl. 55). They frequently follow one about, circling slowly over-head and uttering harsh cries. They manifest a greater diversity of habit than any other of the familiar sea birds. Though not strictly gregarious, they are often seen in flocks of some hundreds, resting drowsily on some interior flat of guano or sand and appearing like groups of white balls on a dark background. More often they are seen isolated or in groups on some slope commanding a view of the water. Favorite positions are on salient points of the shore or small outlying rocks projecting a little above water. Again they are found far away from the islands, floating on the waves or flying slowly after a vessel watching for offal.

The gaviotas make four or five different calls: the familiar *caw, caw,* in flight; the prolonged laugh, *ha-ha, ha-ha, ha-ha, ha-ha, ha* (or *cah-cah*), when standing; a softer and shorter *ca, ca, ca, ca,* (like *ca* in "call") repeated rapidly and staccato while flying; and a sort of clucking sound when at rest.

Near the large fishing camp at Lobos de Tierra, large numbers of the gaviotas regularly congregate to feed on the waste matter at the camp. It was repeatedly observed that while the birds would feed even between the feet of the native fishermen they would fly quickly at the approach of a white stranger.

Gaviotas are not only scavengers of the beaches and rookeries, but are most pernicious in their depredations upon the nests of other birds. I have seen them taking the eggs and fledglings from the nests of pelicans and piqueros, and even robbing eggs from other gaviotas. They break the eggs at the nest or take them into the air and let them fall to break on the rocky ground. They will swallow

entirely a new-born pelican (with considerable effort) or tear a larger one to pieces, contending with the turkey buzzards over the common prey. The concerted attacks of gaviotas and gallinazos on the nests of piqueros is described in another place (p. 498).

Besides doing scavenger duty in the rookeries by feeding on discarded fish or dead bodies of birds, they were not uncommonly seen perched on the floating body of a pelican, which had perhaps been killed by a sea-lion, and tearing at the meat, a position undisputed by the gallinazo. I was interested to determine if they were themselves afraid of the sea-lions. They would always desert a floating body as a sea-lion approached and, though they will rest on the water with the sea-lions nearby, they fly invariably to another position as the "lobo" draws too near.

The nests were found in December, principally at Lobos de Tierra, but a few were observed at Lobos de Afuera. They were generally on the hills, scattered among the nests of the larger piqueros, and lined with a few feathers and seaweed (pl. 56, fig. 1). Three nests were found under the shelter of a low bank upon a beach and close to the water. There are almost always three eggs or young, although one nest was found with five eggs. The eggs are olive green, spotted and blotched with dark brown (75 by 50 mm.). The very small birds have a black bill with light tip, and are covered with thick soft down, gray in ground color but brindled with fuscous; the head is distinctly spotted with dark fuscous on a light gray background. When quite young they will run about, leaving the nest to hide among the rocks as an intruder approaches.

The gaviotas have a variety of color phases with the age and season. The head, at one stage dark gray or nearly black, becomes white-mottled and then pure white; the black tail with white base and tips becomes a white tail with narrow black bar.

The nests of the gaviotas are practically devoid of guano, so that their economic significance depends principally upon their service as scavengers and, on the other hand, their depredations upon other birds.

STERNA HIRUNDINACEA (Lesson).

THE TERRECLE.

Among the terns, particular attention was given only to the "terrecle," *Sterna hirundinacea* (Lesson),[1] and the "zarcillo," *Larosterna inca* (Lesson).

The terrecle is very common in the southern region particularly. The principal breeding places observed were San Gallan (June 25) and the Islas de Santa Rosa at the Bay of Independencia (July 18,

[1] The bill was deep blood red and the tarsus a brighter red, in the specimens of *S. hirundinacea* collected, although Taczanowski describes the parts as yellow and yellowish. The outer third of the upper bill of one specimen was almost black.

1907). This was in midwinter. On the south Santa Rosa, a relatively low, flat-topped island, the nests lay so thickly on the ground, and the eggs were so inconspicuous among the small stones, that, despite great watchfulness, one could not walk about without crushing the eggs. The young birds, however, stood in little danger, since even in the fledgling stage they were wary and exceedingly active; they would run quickly away even to a distance and become almost invisible beside a small bit of gravel. No other birds of the islands were observed to be either so active or so successful in concealment. In the stomachs of two specimens examined there were found chiefly small fishes, the common anchobetas, *Engraulis ringens* Jenyns.

Another tern, very similar to the terrecle in markings, though greatly different in size, is the little *S. lorata* Philippi and Landbeck, the "Churi-Churi" of Paracas Bay, where it was seen most abundantly.

LAROSTERNA INCA (Lesson).

THE INCA TERN OR "ZARCILLO."

One of the most fascinating birds of the coast is the beautiful Inca tern, *Larosterna inca* (Lesson), known in Peru generally as the "zarcillo." At Eten they call it "aromito." Although noted as far north as Lobos de Afuera, it was observed in greatest abundance in the southern region.

The body color is almost uniformly a dull dark blue, but the head and the outer parts of the wings are a little darker, while the under side of the wings is lighter. From the lower part of the base of the upper jaw a pure white band, or "*moustache*" extends backward, below the eye and just above the yellow fleshy flaps, to the region of the ear; there it ends with a half-dozen long slender little plumes that emerge from the feathers, and curve backward, downward, and outward in graceful manner. "The bird with the white earrings" a visitor termed it.

It is altogether a most pleasing bird in its grace of form and movement, as well as in its strikingly neat and even dandified appearance. The soft dark blue of the plumage is effectively varied by the crimson of bill and feet, the white margin of the wings, the yellow flaps at the gape of jaws, and the showy "earrings."

In flight it apparently delights in sharp curves, quick reverses of direction, or sudden drop with webbed feet outspread. The forked tail presents a variety of forms in these maneuvers, now widespread and fan-shaped losing all trace of the fork, now closed in swallow-tail effect, or, again, so snugly closed as to obscure the forked form entirely.

The Inca terns have a most inquisitive habit. Even when there was no probability of being near to the nests, they would circle rapidly

about one, now and again making startling dashes straight for the head, to swerve sharply aside when within but a few feet. The desire to investigate seemed at first the probable motive for such flight. They were observed to practice the same maneuvers over our captive penguin swimming in the water. It is possible that such sudden startling dashes would have the effect of causing larger birds or animals to drop a morsel of food which could be seized upon by the alert terns.

The plaintive call of the Inca tern is somewhat like the cry of a young kitten; although sometimes petulant, it lacks the harsh tone of other terns.

The breeding places of zarcillos are found on many islands; generally they were observed to use the trenches or other places where the surface crust had been broken away in guano extraction, and where the nests could readily be concealed by excavating little tunnels in the bank (pl. 54). Nests with all stages of eggs and young were observed at the Chincha Islands (North Island) in June, 1907. One of the most populous breeding places was the Isla Asia visited in August of the same year. I have no record of nests observed in the summer season although doubtless there is little interruption of the breeding season.

None of the terns have any noteworthy value as producers of guano. A native described the Inca tern as good to eat.

The skimmer, *Rynchops cinerascens* Spix, doubtless frequents the northern islands although I did not observe it near any island. A specimen was taken at Tumbes in January, 1908, where it was not uncommon. Both Tschudi and Raimondi noted its presence at the Chincha Islands (pp. 507 and 508, below).

THE ALBATROSS.

The albatrosses are represented by the "pajaro-carnero" (mutton-bird), or "pajarote," *Diomedea irrorata* Salvin, a beautiful bird, with dusky brown body and white head and neck, little exceeding a cormorant in size of body, but with wing expanse of 8 feet (2¼ meters) (pl. 53, fig. 2). The specimen shown in the illustration was captured when wounded on the ocean and was kept in captivity for some time. Naturally it did not lend itself to domestication and it never consented to take food. The albatross was always seen either flying low over the water or resting upon the surface. Its wing strokes seem slow and deliberate, but the flight is rapid and graceful. It will soar for considerable distances, keeping just above the water and rising and falling with the waves. When resting on the water, and at a distance, one might easily confuse it with a gaviota; but at nearer range its flight and its longer bill readily distinguish it. The pajaro-carnero was observed from the Bay of Independencia in the

south to the Lobos de Tierra in the north. While it was more frequently seen in the south, yet on one trip made in a small boat from the island of Lobos de Tierra to Eten on the coast the pajaro-carneros were nearly always present in numbers; often 30 or more were in view at one time. One was observed devouring a fish about a foot in length.

The pajaro-carnero was never seen on land, and presumably does not breed in that latitude. Native fisherman assured me that the bird never alights (in that latitude) except upon the high sea: "Paran en la altura, no mas."

THE PETRELS.

The family of Procellariidae is well represented on the Peruvian coast, by the Wilson's petrel, stormy petrels, several species of shearwaters, and the diving petrels. The "pardela" *Puffinus griseus* Gmelin, is a sooty shearwater, frequently seen swimming lazily on the surface of the water and relatively tame. I think this is sometimes called "doña." Another and somewhat smaller species, the "pardela tablera," was observed but not taken.

Numbers of small petrels, the stormy petrel, *Procellaria tethys* Bonaparte, the Wilson's petrel, *Oceanites gracilis* Elliot, and others, were frequently in evidence, skimming lightly over the surface of the water or hovering over a school of small fish which was being pursued by bonitos. The stormy petrel is known as the *danzarin* or "dainty dancer"—the most appropriate name possible—descriptive both of its swift, graceful, swaying flight close over the water and of its light, dancing movement with feet and wings when feeding. As we went by sloop from Pisco to Independencia, numbers of them followed our vessel picking up the crumbs thrown into the water. The danzarin seems to alight on the surface of the water, the wings stopping outspread for a moment as they follow the upward and downward movement of the wave. A slight flirt of the wings and the bird is resting again on the surface only a few inches away, while it daintly picks the bits of food from the water.

PELECANOIDES GARNOTI (Lesson).

THE DIVING PETREL OR POTOYUNCO.

Among the petrels, one is of particular interest and importance, the "potoyunco," *Pelecanoides garnoti* (Lesson), a diving petrel, an abundant bird, and a significant guano-producer. In favored locations on the islands they are breeding at all seasons and the guano left in their subterranean chambers is considered particularly rich in nitrogenous matter.

My first acquaintance with these birds was when at night in a small boat we often sailed close by them floating on the surface of the water

and apparently quite unobservant of the boat. Not more than once did I see them on the water by day, though the fishermen said that but one bird of the pair is at the nest during the day, the other remaining out on the ocean. On the islands, as far as my observations go, they are strictly nocturnal, coming and going only after daylight has gone and before the light of morning. They are more readily recognizable by sound than sight, and, as they fly obscurely about over the island, uttering their little croaks, they are very suggestive of bats.

The nests are made in the side of the hill, often just beneath a large rock or sheltered under the hard salty crust. It is an odd experience to sit at such a place and hear the mysterious sounds from subterranean homes. Over and over again, with the voice of a frog, unvaried in pitch or rhythm, they repeat the sequence of notes—two longs, a short and a long, the last note slightly longer than the first two. Another more complicated sound is made by some and it is possible that the calls are distinctive of the sexes.

The potoyunco is comparatively small, measuring about 10 inches in full length from end of bill to tip of tail and weighing half a pound. The general color is black above and white below. The body is thickly covered with feathers, beneath which is a thick gray down, the dense coat making the bird appear to possess a very large body. Viewed from below, the body is oval in form—like a large white egg—the wings and the short, stout neck seeming disproportionately small appendages.

A number of the nests were observed at the Ballestas North Island, and the birds were heard on the Chinchas, but the lofty San Gallan was the chief island for potoyuncos, as the potoyuncos were easily the principal bird of this large island.

San Gallan, 2.5 by 1.5 miles, is mostly dry, barren, and dusty, but with high hills reaching well into the clouds, and only there, in the moist altitudes, teeming with plant life. Everywhere over the island are large spots perforated by the holes of the potoyuncos, as they undermine the hard, dry crust of the lower hillsides or burrow back underneath the vegetation of the cloud-wrapped peaks more than a thousand feet above sea level.

Searching for these birds in the daytime one is guided only by the openings of the burrows, for their voice is rarely heard during the day. One may try quite a number of nests without result, as the burrow may either be unoccupied or, more often, too deep for the arm to reach to the nest. Still, so abundant are the nests on San Gallan, that a considerable number of birds or eggs may be captured in an hour or two. Once reached, the birds are easily taken, as they make almost no effort at resistance. Sometimes, after they are out, they try to bite, but without inflicting injury. Occasionally they would rush into the hands held at the mouth of the burrow.

At night it is much easier to take them, when guided by the voices one may avoid exploring the unoccupied homes. It is thus that the laborers and fishermen catch them abundantly, for the potoyunco is valued for food in fresh or salted condition.

If liberated they run rapidly over the ground flapping their wings, but unable to rise except after a run of 10 or 20 feet. Then, with exceedingly rapid movement of their short wings, they make for the ocean with a queer zig-zag flight. Reaching the ocean they fly low over the water a little distance, settle upon the surface, and then swim away with short, shallow dives.

When placed on the ground in my tent, the petrels displayed peculiar movements. The body is covered with a very thick coat of feathers so that lying on the ground the body seems to flatten out remarkably, while the wings, pushed a little out on the sides, increase the apparent width until the body has quite a turtle-like form. As they crawl rapidly along, the legs are spread well out to the sides and the body is barely, if at all, lifted from the ground. I noticed that with some the body was slightly raised; with others not at all. In any case the movement is a reptilian creep rather than a walk. When I started one under my sleeping bag it began to burrow, with strong backward sweeps of the feet, used alternately and sending the dirt flying with great force. Two birds were placed outside in holes in the ground, each secured by a line attached to the leg. They made a little effort to burrow, but soon stopped. At 10 o'clock at night I found them trying to go toward the water. Placing them back in the holes I left them again, hoping to ascertain the rate of excavation. Unfortunately, in the morning only the bones of the legs remained, and the tracks of gallinazos accounted for the disappearance of the birds.

Presumably both condors and gallinazos (buzzards) may be accounted enemies of the potoyuncos, although their subterranean life and nocturnal flights give them substantial protection from predatory birds. Certainly the chief enemy is man. About the signs of old campfires numberless wings of the potoyuncos were often observed. For a while I was puzzled by the many signs of sacks having been dragged down the hillsides, until it was observed that these trails led in almost every case to the grounds where there were burrows of potoyuncos, even to those near the very tops of the peaks. The ground was not torn up as if guano had been the object of search, and the abundant evidence of discarded wings of potoyuncos completed the story. The fishermen assured me that these birds were very good when salted, and that the laborers on the islands regularly brought back quantities of potoyuncos salted down. The fishermen with me asked permission to take the birds for food. This was refused; but with little effect, for I counted 21 birds drying

in the sun one morning and know that they had first eaten all they had wanted.

A great many nests were examined, to find in each nest, if tenanted, only one egg or one young bird. The eggs are purest white, with very thin shells, and they are very variable in shape. Some are short and well rounded, with little difference between the ends, while others are very elongated and rather pointed at the smaller end. The measurements of six eggs of the potoyuncos were as follows:

Dimensions, in centimeters, of eggs of Pelecanoides garnoti.

	1	2	3	4	5	6
Length	4.85	4.75	4.5	4.5	4.35	4.3
Transverse diameter	3.1	3.6	3.4	3.3	3.3	3.4

A "pichon," or fledgling, at the stage when the wing feathers are first appearing, is a large shapeless mass of fat and down, with nearly the dimensions of its parents and of equal weight (about 7 ounces). Its soft coating of gray down measures 3–4 cm. in thickness (1½ inches, more or less). If a single tuft of down is pulled out, there is found growing out of the blue sheath the delicate little feather, which for about 1 cm. is white (if from the lower side of the body) or black (if from the back); many of its barbs are tipped with delicate plumes of down, which are dark gray for about 2 cm. and possess white tips of 1 cm. length. The head protruding from this great ball of down appears almost bald having only a close crop of gray down.

Valued as they are for food and readily open to capture, the potoyunco must eventually be brought near to extinction unless effective efforts for its protection are made. It will be unfortunate, indeed, if the potoyunco and the penguin, two water fowl which produce a fertilizer of high quality, shall, through mere human negligence or wastefulness, become lost to the guano industry. Valuable the potoyuncos may be as food, or the penguins for the skins or fat, and we may impose little personal blame on those who desire the food or the skins or the oils; but the fact remains that when the food or the skin and oil is taken the bird is lost to the future, while the removal of the guano is a benefit gained without loss. With due care each of these important species may not only be preserved to the future, but may be restored to a condition of far greater abundance and value than at the present time.

THE GANNETS.

The Sulidae or gannets are represented on the Peruvian coast by two species, the abundant *Sula variegata* (Tschudi), third in importance

among the guano birds, and the larger but far less common form of the north, *Sula nebouxi* Milne-Edwards. Along the greater part of the coast *Sula variegata* is known as the "piquero."[1] In the north, however, as at the Lobos Islands where the larger species of Sula is found, the latter is called "piquero" while the smaller *Sula variegata* is commonly known as the "camanay."

SULA VARIEGATA (Tschudi).

THE VARIEGATED GANNET OR "PIQUERO."

The common "piquero," sometimes called "camanay," is a beautiful bird with head, neck, and breast of pure white, the back and upper surface of wing variegated with dark and light fuscous and white, while the sides and belly are nearly pure white; the feet, legs, and bill are blue, and the eyes are ruby in color (see pls. 57 and 58). The piqueros are almost omnipresent on the Peruvian coast, and undoubtedly they are the most abundant of the sea fowl. Along the mainland shore and about the islands of any size, there is scarcely a cliff but is more or less dotted with the nests of piqueros (pl. 59).

It is a striking sight when a single gannet, after circling over the water until its food is seen, turns suddenly head down and falls precipitately into the surface of the sea to disappear from view; after a few moments it reappears on the surface to swallow its prey before rising to fly at varying heights until tempted for another plunge. Sometimes they seem to drop from nearly a hundred feet, while the wings are held slightly opened to direct the head-long course; again they fall from only 10 or 15 feet, or they may simply dash themselves into the water when barely risen from the surface. Ten or 20 or 30 birds are not infrequently seen to fall simultaneously with a loud splash and dash of spray.

The writer had a rare experience that seems worthy of record. While passing from the Chincha Islands to Pisco in a fisherman's rowboat, we saw an actual cloud of thousands of piqueros flying over a school of anchobetas, when suddenly they began to fall, hundreds at a time until practically the whole cloud was precipitated into the sea before the first birds had risen from their brief rest after emerging from beneath the surface. Scarcely a bird was seen in the air. The first to fall were soon up, however, and from that time on the plunges were uninterrupted. Changing the course of our boat a little we soon rowed directly through this downpour of birds. Hundreds of birds seemed to strike the water at every instant, and even within a few feet of our boat. The bewildering effect is to be imagined rather than described; the atmosphere "cloudy" with birds; the surface of the sea broken and spattering from falls of animate drops and speckled

[1] Pronounced pē-kā'-ro. Accent on second syllable.

with reappearing birds; the confused sounds of whirring wings and unremitting splashes.

The food of the piqueros, as far as I observed it, consisted principally of anchobetas, *Engraulis ringens* Jenyns; like other sea birds they doubtless feed upon what is most readily available, and they too, doubtless, regale themselves with the small crustacean, *Munida cokeri* Rathbun, which is sometimes so abundant as to form veritable "red seas" of great area.

The piqueros seem to prefer the rougher and more inaccessible places for breeding (see pl. 59). Thousands of their nests may be seen upon the face of abrupt cliffs, as at the Chincha Islands; at that particular place they overflowed the cliff, so that a few nests were found on the level ground at the top. This, in fact, was the only place where piquero nests were seen on real table-land. At Guañape (pl. 58) and Lobos de Afuera, many nests were found on very steep and rugged slopes high above the water and approachable only with considerable difficulty. The nests are hollowed, shelflike masses of guano built on some scant ledge, and are usually as closely crowded as circumstances permit. The adult birds readily desert the nests on the approach of an observer, and one must wait with some patience for their return. Since the breeding season is continuous throughout the year, one may at any time find eggs and all stages of young. The nests contain from 1 to 4 eggs, a considerable proportion of them having as many as 3. Nine out of 25 nests counted at one view had 3 eggs. The eggs are a pale blue, smeared more or less with a white, chalky coat, are little pointed and are generally rather uniform in size. The measurements of 5 specimens from the Lobos de Afuera Islands (December 1908) and of 3 from the Chincha Islands (June, 1908) are as follows:

Dimensions, in millimeters, of eggs of Sula variegata.

	Lobos de Afuera Islands.					Chincha Islands.		
Long diameter	53	61	62	62	61	60	62	59.0
Transverse diameter	40	43	43	44	41	42	43	39.5

The immature birds have the skins of exposed parts of the same color as in the adult except that the tarsus and feet are lighter, in effect a bluish gray. The iris, however, is yellowish gray, instead of clear ruby, as in the adult. The primaries, secondaries, tertiaries, greater and middle coverts, scapulars, and tail feathers, appear before the birds are of full size (pl. 56, fig. 2). Specimens with the breast and belly feathered, upper tail coverts present, and back feathers appearing, show the adult measurements. The feathers of the breast and belly are of light fuscous or gray widely margined with white. The

feathers of the shoulders are dark fuscous scarcely tipped with white, and a band of similar feathers extends to the breast around the base of the still down-covered neck. The upper surface of the wings is as in the adult, except that the colors, as everywhere on the body, are duller. A conspicuous feature of the immature birds is the cross of white down on the rump which long persists while the rest of the body is becoming fully feathered. The predominant white colors of the adult bird are not evident until a late phase. The young when abandoning the parental nest have practically the entire head, neck, and body a variegated fuscous. At this stage the birds are easily confused with the larger species, *Sula nebouxi*, unless the measurements are considered.

The young birds go through much home practice in flight before starting away from the nest. They will stand in the nest flapping the wings continually for a long time, or, facing the wind and assisted by its power, will rise in the air to remain in an almost fixed position for a considerable time flapping the wings strongly all the while, and then gradually receding to the nest. These practice flights were repeatedly observed, the young birds getting only 3 or 4 feet above the nest and 2 or 3 feet forward, and thus remaining for a minute or more.

Von Tschudi[1] ascribed to the *Sula variegata* the chief rank as a guano producer, and his mistake has been frequently followed. There is reason to believe that the habit of this species as regards choice of nesting site has undergone some modification since Tschudi's time.[2] Tschudi was a very careful observer and he spent some years upon the coast, but he expressly states in his Ornithologie (p. 313) that none of the birds nest on the mainland, but only on the barren islands. Such a statement certainly could not be made in the present time. Unless the habits of this bird have materially changed during the past 70 years, Von Tschudi was misled by observation of the evident abundance of the Sulas; and his mistake has been too frequently followed in nearly all reference books. This species now ranks a very poor third in economic importance, being far exceeded by the cormorant and the pelican. Yet this may not be the case in future. As has been previously mentioned, the piquero frequents the rough and scarcely accessible places and even the abrupt cliffs; and, while practically no place is entirely inaccessible to the intrepid guano workers, it is evident that from such positions a large proportion of the guano must be lost by falling to

[1] Tschudi, J. J. von. Travels in Peru during the years 1838–1842. Translation by Thomasina Ross. New York, 1852 (p. 168). Also,

Tschudi, J. J. von. Untersuchungen über die fauna Peruana. 2 vols. St. Gallen, 1844–1846. Vol. 2, Section: "Ornithologie" (p. 313).

[2] Raimondi also believed that *Sula variegata* produced more guano than pelicans or cormorants, because they keep themselves in the interior of the island (not confirmed by a later statement. See p. 508.)

the water below, and that even entire nests will break away when too heavy and drop into the sea (pl. 59) In some cases, a small beach below may serve to collect the falling guano and keep it available for extraction.

It is not thought to be by any means physically impracticable to build shelves at the base of cliffs or to contrive other means for conserving the waste guano from the nests in such places. This will not be done, however, so long as the extraction of guano at any particular situation is subject to lease to any one of several competitors. The contractor who would incur large initial expense for construction of such equipment must be assured, not only of his own exclusive privilege of taking the guano from such situation, but also of his license and power to protect his property from depredation or damages. Von Tschudi found that a single *Sula variegata* (piquero) in captivity would produce 3½ to 5 ounces of guano a day. (See his Travels, p. 169.) Supposing 1 ounce of this to be deposited at the island each day (a low estimate), it is evident that a thousand piqueros would produce 365,000 ounces a year, or $11\frac{4}{10}$ tons a year—or a million birds 11,400 tons, say, practically half a million dollars' worth. The numbers of Sulas on the Peruvian coast and islands would far exceed the million. The piqueros, therefore, offer one of the best opportunities for hope of increase in the amount of extractible guano.

One of the illustrations shows a cliff at the Chincha Islands on which there were at least 1,000 nests. Guano to the amount of many tons is formed at such a place each year but is almost entirely wasted by falling into the sea.

It has been mentioned, too, that in this case, at the Chincha Islands, a few piqueros were found to have their nests on the table lands beyond the top of the cliff. It is not impossible that, were the islands less frequented and the bird quite undisturbed, a larger proportion would frequent the level ground where the guano of the nests would be entirely preserved. This appears to have been the case in the time of Raimondi.[1]

While the *Sula variegata* occurs along almost the entire coast of Peru, it is more especially a bird of the southern region. Very abundant as far north as the Guañape Islands, it is less conspicuous there; there is, however, a considerable rookery at the Lobos de Afuera Islands still farther north. A little farther north, at Lobos de Tierra, this species is far less numerous; the other and larger species of *Sula*,

[1] Raimondi, A. Mémoire sur le huano des îsles de Chincha et les oiseaux qui le produisent. Comp. rend. Acad. Sci., vol. 42. Paris, 1856.

Raimondi, Antonio. El Peru--estudios mineralogicos y geologicos. (Ser. 1.) Volumes 1-4. Publicado por la Sociedad Geographica de Lima 1874-1902. Article entitled: Apuntos sobre el huano y sobre las aves que lo producen. *In* volume 4, 1902, pp. 489-496. This article is evidently based upon the earlier paper just cited, but seems to represent a revision.

next to be described, takes its place to some extent. In going north, the *nebouxi* was first seen in any numbers at Lobos de Afuera, where the diminution in abundance of *Sula variegata* was first detected.

An account of *Sula variegata* in the Galapagos Islands is given by Snodgrass and Heller,[1] but their observations regarding the habits of this bird are at variance with mine. They say:

> No nest is constructed and generally only one egg is laid by each female. On Culpepper Island we saw some nests containing two. They snap their beaks viciously at the foot or leg of the intruding person, and a nesting bird can not be forced to leave her egg.

They observed the nests apparently only upon the level ground. The measurements which they give, however, are far too large for those of *Sula variegata*. Every measurement given in their table on page 245 is from 10 to 20 per cent too large for *variegata* if the measurements of my specimens taken in the type region are correct. They also state that the bill is "light orange-red, yellowish at the tip and along the commissure," which does not conform to the original description of the species. *Sula* (*Dysporus*) *variegata* was described by von Tschudi from the coast of Peru (Ornithologie, p. 313), and, while his description is not given in great detail, it is unlikely that my specimens were far from being typical. It seems possible, therefore, that their identification was incorrect. *Sula variegata* has a bluish horny colored bill, nests in Peru now chiefly in rough or precipitous places, and has from 1 to 5 eggs for each nest. The adults are not relatively noisy and desert the nests readily when approached.

It may be noted that the specimens from which the measurements of Snodgrass and Heller were made were fully as large as the specimens of *Sula nebouxi*, although *variegata* is a much smaller bird. Their observations of the color of *nebouxi* agree with mine. Their statement that its breeding habits are different from those of both *S. variegata* and *S. piscatrix websteri* in that it invariably nests on cliffs would indicate a very striking difference of nesting habits between the birds of the same species on the Galapagos Islands and the Lobos de Tierra relatively. *S. nebouxi*, as related below, was never observed nesting except on the more level ground. Nelson[2] gives some account of *nebouxi* as observed on the Tres Marias Islands, west coast of Mexico. Nelson writes:

> They were breeding abundantly on the beaches and on a low flat area that covers a part of the former island (Isabel). They were most numerous on the open beach a little above high-water mark, but dozens of them were seen with their eggs farther back among the bushes [p. 31].

[1] Snodgrass, Robert Evans, and Heller, Edmund: Papers from the Hopkins-Stanford Galapagos Expedition, 1898-99. XIV. Birds. Proceedings Washington Academy of Sciences, vol. 5, pp. 231-372. 1904.

[2] Nelson, E. W. General account of the islands with reports on mammals and birds. *In:* North American fauna. No. 14. Natural history of the Tres Marias Islands, Mexico. United States Biological Survey, 1899. pp. 1-97.

Raimondi's observations of the nesting places of *S. variegata* (quoted on p. 508, below) agree essentially with mine.

SULA NEBOUXI Milne-Edwards.

THE PIQUERO MAYOR (GREATER PIQUERO).

The larger *Sula*, the blue-footed booby, gray gannet, or "piquero," was not observed south of Guañape Islands (8° 35′ S.), and it was, therefore, a surprise to me afterwards to learn that the range of the species is given as from the Gulf of California to Chile. The original specimen described by Milne-Edwards [1] was assumed to have come from Chile, but it is not clear upon what evidence the southern records are made.

In color and habit the blue-footed booby is in striking contrast to the smaller white-head species, except in the manner of feeding and in this there are noteworthy differences. The showy white markings of the *variegata* are wanting, the plumage of all upper parts being variegated, and the eyes are yellow instead of ruby (pl. 60). In breeding habit the nests are widely scattered on the level ground or gentle slopes. In feeding, the *nebouxi* was often observed to use localities which the *variegata* did not frequent. At the Lobos de Tierra islands the gannets of the larger species were almost constantly feeding in the very shallow water near the gentle beach in front of our camp. The white-head gannets frequently passed over this place but never plunged into the shallow water. I never observed them feeding except in the deeper waters and generally plunging from some height.

The gray gannets would circle about over the bay, often with the bill pointing directly down, as they searched the water for their prey. If a little off-shore they might plunge from some height, but, in the shallow water two or three feet in depth near the beach, the drop was made from only a few feet above the surface or else the bird dived at an angle when flying barely above the water. Between times they were resting with the pelicans on the low rocks near-by.

When this piquero plunges, the wings are held out angularly, and just as the bird is about to enter the water the wings are folded to the body. The bird emerges very promptly and may rest a few moments on the surface or at once arise in flight. Sometimes it seemed to find itself too high for the contemplated drop, when it would descend by a spiral course of flight to a proper level for the plunge. I observed a gannet dive vertically from the air into the water that was only about 6 inches in depth, while another more prudent bird dropped to its feet in the water at nearly the same place and then secured his prey. It is interesting to note how frequently the piqueros of this

[1] Milne-Edwards, A. Recherches sur la faune des Regiones Australes. Annales des Sciences naturelles Zoologie, ser. 6, vol. 13, art. 4, pp. 36, 37. Paris, 1882. [See p. 37 and pl. 14.]

species are associated with the pelicans. A few are often seen standing among a group of pelicans resting on a hillside. They not uncommonly accompany the pelicans in flight, and I have seen them joining with the same birds in the characteristic bathing act. When flying from the land the *nebouxi* rarely rises except after using its feet on the ground for a few yards, just as the pelicans do; yet they will rise at once from the surface of the water, and without the slightest apparent difficulty or delay. On the whole, the larger gannet is less active in flight and far inferior to the white gannet in grace and elegance of form and body.

The nests are not made in compact rookeries, but are widely scattered over the hills and valleys for many square miles of the island and are interspersed with nests of gaviotas (pl. 56, fig. 1, and pl. 60). As with the other species, no labor appears to be expended in the construction of the nest. The eggs or young are usually found in a slight hollow in the ground which is, however, apparently but an incidental result of the movements and the deposits of the nesting birds. In the newly formed nest with a single egg, the hollow is scarcely perceptible, but with longer use the nest becomes very distinct. After the young birds are able to stand and to move about, all traces of a nest disappear until soon there is no clue as to where the eggs were laid.

The nests contained from 1 to 3 eggs or young; thus, of 54 nests examined, 18 contained 3 eggs or young birds, 25 contained 2 eggs or young, while 11 had only 1 egg or 1 nestling. In no case did the young birds, whether 2 or 3, seem to be of the same age—there was always a series, as if hatched at different times. (See pl. 60, fig. 2.) Of 39 nests without unhatched eggs, 12 had 3 young, 19 had but 2, and 8 had only 1. The eggs are pale blue, having a distinctly blue shell mostly covered by a thin bluish chalky coating. The form is various but usually ovoid and rather elongate. The measurements of several eggs were as follows:

Dimensions, in millimeters, of eggs of S. nebouxi.

	Long diameter.	Transverse diameter.		Long diameter.	Transverse diameter.
1	64	40	5	60	44, 2 eggs from one nest.
2	67	39 } 3 eggs from one nest.	6	65	40.
3	65	38	7	61	61.
4	63	41, 2 eggs from one nest.			

A very small egg that measured only 49 by 35 mm. was found to have no yolk.

The adult birds of this species excel all other birds of the islands in the boldness with which they will defend their young. If only

eggs are present the parent birds will, after some threatening croaks or whistles, fly when the observer is within a few feet; but they will cover the small young, or stand by the larger nestlings, and often vigorously defend them with their bills. When first examining the nests, it was necessary sometimes to push the bird from the nest to discover the young occupants. Once separated from the nest, the bird gives up the fight and flies away some little distance to remain until the intruder departs. The gallinazos, however, are usually even more prompt than the parent to find the exposed nest and eagerly devour the eggs or young. On a later page it is told how a gallinazo or a gaviota will provoke a gannet to attack in defense of its home, while other birds will then ravage the nest. As with the other gannets and the pelicans, it is the habit of the *nebouxi* to disgorge the fish from its crop before starting in flight, presumably by way of "throwing over ballast" to facilitate escape.

There are very evident sex distinctions. In every pair, one has a large black pupil and narrow yellow iris and quawks vociferously when an intruder approaches the nest; the other has a small pupil and broad iris, manifests a darker ground color of head, and utters only a hoarse whistle when approached. The supposition that this distinction corresponds to sex was not verified at the time by killing the birds for examination of the gonads, but I find that, of the pair which I killed and sexed on another occasion, it is the male which displays the darker ground color on the head, with more sharply contrasting white streaks, and the same is true of other specimens in the United States National Museum. Of 23 nests in which the parent birds were carefully noted, 11 were covered or guarded by the male (whistling parent with darker head, etc.), 8 by the female (quawking parent), and 4 by both. The immature but grown young are much darker than the mature males or females especially as to the head, and they show no yellow in iris. All the young seem to make the quawking sound.

The season of breeding seems to be uninterrupted. When the Lobos de Tierra Islands were first visited, March 29 to April 6, 1907, nests with eggs, with newly hatched young, or with feathering birds, were found in nearly equal proportions; and this was also the case at the second visit in early December of the same year.

In spite of its habit of nesting upon the level and accessible places, this species does not seem to be of high relative importance for its guano production. Its guano is so widely scattered over the ground as not to be readily appreciable in a season, but undoubtedly, in the long run, the production of guano is of distinct value.

The distinctive features of the two Peruvian species of Sula are indicated by the following comparison:

	S. variegata.	*S. nebouxi.*
Measurements		10 to 20 per cent greater.
Iris	Ruby	Pale yellow.
Foot and tarsus	Dull blue	Brighter sky blue.
Head and neck	Shining white	Brown spotted and streaked with white.
Breeding habit	Nests on roughest places or on cliffs, as closely aggregated as possible.	Nests on the level ground or gentle slopes, widely scattered, along with nests of gaviotas. Bold in defending young.
Habit, general	Clannish—not often seen at rest except at the rookery.	Spends much time on the islands, resting on the rocks of the shores or on the hillsides, frequently with the pelicans.

THE CORMORANTS.

The three species of cormorant of the Peruvian coast are, as will be seen, conspicuously distinct in plumage and in habit. The members of each species are numerous, but only one is of great significance economically. This is the "guanay" (*P. bougainvillei*), the most important guano producing bird of the coast. Strangely enough, this species is a less familiar one than either of the other two, although exceeding either of them in abundance. One may not visit a pier without hearing the grunts of the "cuervo de mar" (*P. vigua*); one may hardly take the shortest trip on the water without seeing the scarlet-footed "patillo" ("little duck," *P. gaimardi*) scurrying low over the water; but one may be ignorant of the most abundant species, unless by chance his boat pass near a cloud comprising perhaps hundreds of thousands of the "guanays," or, unless the solid black crest of some islet be pointed out as a rookery of "guanays."

PHALACROCORAX BOUGAINVILLEI (Lesson).

THE WHITE-BREAST CORMORANT, OR "GUANAY."

It need not be inferred from the previous remarks that the guanays occur invariably in enormous aggregations, for there are many relatively small rookeries. A flock of considerable size was noted at the Lobos de Tierra Islands, crowning an islet off the west side of the northern portion of the main island. A "loberia," or rookery of sea lions, bordered the lower portion of the island. Several birds were seen also at the Lobos de Afuera Islands, where no rookery was observed. Smaller rookeries were found at the Pachacamac Islands and Asia.

The preeminent home of the guanays, at least in 1907 and 1908, was the double group of islands off Pisco in the south, the Ballestas and the Chincha Islands (pls. 61 and 62). Each of the two island groups, which are only 5 nautical miles apart, comprises three principal units, those of Ballestas, the southerly group, being much smaller and much higher than the Chinchas. In each case we have

the "Isla de Sur," "Isla del Media," and "Isla del Norte." These islands are about 11 nautical miles from the port of Pisco, or about 4 and 9 miles, respectively, from the point of Paracas Peninsula. They are the most famous in the history of the guano industry; small as they are, and without a single permanent human habitation, the name of Chinchas is known to every seaport in the world.[1] Between 1850 and 1872 nearly 11,000,000 tons of guano are said to have been exported from these islands alone, and almost the entire deposit appears to have been of very high quality, with 13–14 per cent of nitrogen and about an equal proportion of phosphoric anhydride. The value of such a deposit at ordinary prices would be nearly three-quarters of a billion dollars, but the area of all the islands if combined into one would not be greater than that of a small-sized farm.

When the Ballestas were visited in May, 1907, each of the three islands had large flocks of cormorants, all of which, however, had been disturbed by the opening of the season for the extraction of guano. The smallest of the three flocks had occupied the southwest corner of the north island, beyond the bluff and on comparatively level ground. The main part of the rookery was bounded by nearly straight lines, being 85 meters in length, with an average width of 54 meters. The area was, therefore, approximately 4,600 square meters.

The south island of this group is some 300 feet in height and difficult of ascent. Its small top was nearly half covered with a compact rookery of between 10 and 12 thousand square meters. The area of the breeding ground on the middle island was only slightly less. In all, about 150,000 birds had nested at these islands during the preceding summer, for it was found that we could safely estimate the flock at about six breeding birds to the square meter.

At the Chincha Islands, visited in June, 1907, the guanays were using only the south island. But here was a rookery which for its size and compactness can scarcely be rivaled in any part of the world (pls. 61 and 62). Sixty thousand square meters of ground, or 15 acres, were closely covered with cormorant nests. It occupied about two-thirds of the surface of the island, embracing the crown and the gentle slopes of the hill surmounting the island. The nests were very uniformly spaced, about three to the square meter, and not an available meter of ground within the outside limits of the rookery was unoccupied. In one place 39 nests were counted in 12 square meters; in another, 52 nests in 18 square meters; in a third place, 33 nests to 9 square meters. These places were not more crowded than any other points within the limit of the rookery, the

[1] No less than 346 vessels are said to have embarked guano at the Chinchas Islands in 1858 (p. 205 of "Derrotero," previously cited, p. 453.)

spacing of the nests (as shown in pl. 63, fig. 2) being practically invariable and determined apparently by the minimum space requirements of a pair of breeding birds. One may safely compute the number of breeding adults by multiplying by 6 the number of square meters covered by the aggregation.

At this time, the close of the breeding season, the immature but grown nestlings were still being fed by the parents from mouth to mouth and occupied the parental nest. Estimating on the basis of two birds to the nest and three nests to the square meter, there would be 360,000 parent birds in the flock, with undoubtedly an equal or greater number of immature birds able to fly, about three-quarters of a million birds in all.[1] I had the opportunity to revisit this island briefly in the following month of July to find the flock at least 50 per cent larger, practically the entire island being occupied. The increase in size of the flock in this brief time may have been due in part to the accession of birds from the Ballestas Islands, but undoubtedly in part a natural expansion, as the older birds of the past season's brood mated and established homes of their own.

The photograph shows the form and arrangement of the nests on the hillside (pl. 63, fig. 2). The nests are rather less regular in distribution than at first appears. Whatever may have been the origin of the nests, they were now composed entirely of guano except for the little gravel or stone which was mixed with the guano. Each nest is like a shallow basin with heavy rolled rim, the diameter of the hollow of the basin being 20 cm. (8 inches) and that of the circumference of the rim 40 cm. (16 inches); the raised ring of guano surrounding the hollow is then about 4 inches wide. The nests, however, are not separate, but are portions of the continuous carpet of guano. The distance from center to center of nests varies from 50 to 70 cm., being generally a little less than 60 cm.

The young birds in the early days of June, although able to fly from the island with the older birds, were continually seen to be nagging the parents for food, pecking at them and expanding the throat to form a receptive pouch. When the food is conveyed the head of the young disappears entirely down the long throat of the parent and the two bend over to one side or the other, the brother young bird meantime making every effort to interfere and displace the more fortunate nestling. Even at this time there were among mature birds suggestions of preliminary love plays in the raising and lowering of crests and the brushing together of the birds of a pair. It was several weeks later when this island was revisited (in

[1] I am aware that others have estimated the number of cormorants at this island at much higher figures—up to 10,000,000; in the absence, however, of precise data regarding the method of computation employed, such estimates are to be viewed with conservatism at least.

July) and many eggs and even a few young nestlings were found. It is evident, therefore, that there is scarcely a "closed season" for parental responsibilities in this species.

Occasionally a wanderer bird is seen to be driven relentlessly from place to place as it works its way through the crowd. What was the significance of this I could not detect; whether it was a bird away from the proper nest or one without a mate, its unwelcomeness was unmistakable.

It is the habit of the guanays to remain on the islands the greater part of the time. They appear to leave only in search of food. They form, indeed, a great "breeding class." They walk more than either of the other Peruvian species of cormorant and their erect position and waddling gait is quite suggestive of the penguin. At a casual glance the birds in the photograph (pl. 61) might easily be mistaken for penguins.

Unlike pelicans, the guanays will return to some extent to rookeries whence they have been disturbed during the preceding season, although a preference for undisturbed islands was most clearly indicated by the growth of the flock on the South Chincha Island. When I revisited the island in 1908, a considerable number of guanays were still using the Ballestas islands, although the rookery was entirely broken up in the preceding year.

When one approaches a rookery the guanays crowd away with much grumbling, and when once a few birds arise in flight, the movement is liable to spread through the entire flock until hundreds of thousands are on the wing, even most of those that were too remote from the intruder to know the cause of the disturbance. It was found with these, as with other birds, that, if one waits motionless and with much patience, the birds will after a while return to the nests and gradually close around the observer, until at last only a circle with radius of 3 or 4 feet is left vacant. While in every direction one is surrounded by acres of birds all of a single species, the scene is yet peculiarly variegated. In one direction the birds are turned watchfully toward the intruder, and the thousand white breasts make a glistening white groundwork spotted with black heads; in another direction the birds are turned in side view so that the breasts show only as white streaks. Additional effects are caused according as the birds are more or less compactly grouped. Close around one, the metallic green heads, the green-lustred backs, sides and legs, the white throats, breasts, and bellies, and the hundreds of intent green eyes are most conspicuous. The voice of a single bird is a sort of a croak, less deep, less hoarse, and less powerful than that of a bullfrog, but somewhat of that character. The collective voice of the flock of hundreds of thousands is indescribable except as it

may be suggestive of the sullen mutterings of a disgruntled mob of human beings.[1]

When the guanays leave the island in search of food they appear as a long black cloud several miles in length, streaming low over the water until they settle down to form a large black blotch on the urface of the sea. As a flock in flight rises on approaching an island it may be seen that the birds do not form an indeterminate mass, but are distributed in lines that bend and sway, ascending, descending, or swerving from side to side. The position of these varying curves at any moment could be reproduced by a drawing or a photograph; but the pleasing effect of the wave-like movement of the lines intersecting each other at ever-varying angles is impossible of representation.

The guanays are afflicted with parasites, but to a far less extent than the pelicans. One of the parasitic insects is said to inflict a very pernicious bite on human beings.

The economic importance of the guanay will be discussed after treating the other species of cormorants of the Peruvian coast. (See p. 482.)

PHALACROCORAX VIGUA (Vieillot).

THE BLACK CORMORANT OR "CUERVO DE MAR."

The "cuervo de mar" ("sea crow") is the common cormorant of the docks and piers of the coast as well as of the inland waters. They are rarely seen in long flight, but are almost invariably observed close to the shore swimming on the water or diving from low perches. They are generally in comparatively small groups, not exceeding a few hundreds in number.

In appearance this is the least attractive of the cormorants. Its general color above and below is dark brown, the back and belly showing some dark green. The naked parts are dusky black, except for the yellowish skin at base of jaws and chin. The large pouch-like throat enables them to swallow comparatively large fish, but gives them a coarse appearance. A long crest on the lower half or two-thirds of the neck can be raised like the bristles on a hog's back. The voice is a hoarse grunt. Walking over the long pier at Pisco for the first time persons not infrequently suppose that pigs are in some way penned below the pier, being misled by the grunts of hundreds of cormorants resting on the iron tie-rods and braces below.

The cuervos dwell little on the islands. At the Chinchas and Ballestas opposite Pisco, a few are commonly seen perched in line on the

[1] These notes regarding the voice of the guanays, individually or collectively, are transcribed verbatim from my field notes made in 1907. Forbes (1913) derived a strikingly similar impression. He says: "At times the noise is just like the sough of the sea and at others it resembles the sound of a great crowd, all the members of which are talking at once." Additional notes of interest regarding this cormorant are comprised in his paper, cited as follows: [Forbes, H. O.] The Peruvian guano islands. The Ibis, ser. 10, vol. 1, Oct. 6, 1913, pp. 709–712. (Under "Notes and Discussion.")

slanting aerial trolley wires or on the low rocks near the shore. They remain generally motionless, though grunting noisily, but occasionally fly down into the water to dive for fish. They seem to prefer the bottom fish or shallow-water fish close in shore, such as the "trambollos" (blennies), which one may see from the rocks in almost any suitable place. The cuervo can swallow fish of considerable size, and I have found in the stomachs trambollo fish from $2\frac{1}{2}$ to about 10 inches in length.

The nesting places were observed only at the Lobos de Tierra Islands in the north in midsummer—December, 1907. It is not doubted, however, that a visit to the southern islands at the same season would have revealed nesting places in that locality. The choice of nesting site is characteristic and is well shown in the illustration (pl. 64). They were using small rough-topped rocks lying close along the shore, but partly or entirely cut off from the shore proper.

The nests contained from one to five eggs or young, usually four eggs or four young birds. The eggs are comparatively small and pale blue in color, the blue somewhat obscured by a chalky coating which is not uniformly disposed. They were variable in shape. Four eggs from one nest were of an ordinary oval form, 53 by 36 mm., and these were representative of most of the eggs observed; one nest, however, contained five greatly elongated eggs. The nestlings were black.

Dimensions, in millimeters, of the eggs of the "Cuervo de Mar."

	Long diameter.	Transverse diameter.		Long diameter.	Transverse diameter.
1	52	35	5	60	34
2	54	36	6	62	35
3	53	36	7	60	35
4	53	36	8	60	35
			9	61	34

Characteristic form. Unusual form; 5 eggs from one nest.

As compared with the guanay, the tail of the cuervo is rather long, the bill rather short, and the bird is lighter in build. Its weight, about $3\frac{1}{4}$ pounds, is a fourth less than that of the guanay. The iris is green in both species.

The cuervo ranges probably the entire length of the Peruvian coast from Tumbes in the north to Chile, and it extends to the inland waters.

The cuervo de mar is excellently described by Taczanowski.[1] It must be remarked that in the specimens from which my color notes were made (Lobos de Afuera, November and December, 1907), the white feathers on each side of the auricular region, as described by

[1] Ornithologie, vol. 3, pp. 429, 430.

Taczanowski, were wanting. These white marks were noted, however, in examples observed at Pisco in June, 1907.

PHALACROCORAX GAIMARDI (Garnot).

THE SCARLET-FOOT CORMORANT OR "PATILLO."

The patillo, *P. gaimardi*, though less familiar to the landsmen, is a not less common cormorant than the preceding. To anyone navigating in small boats along shore or among the islands the patillo is a familiar feature of the seascape. One meets them floating lazily yet watchfully on the water, occasionally flapping wings or ducking beneath the surface as enjoying a bath, or making a sudden dive for prey to come up with a fish or a wriggling eel, which is swallowed only after a little struggle. They seem to be peculiarly successful eel catchers, as I have many times seen them with such prey. This species bears many local names. Among them are "pato de mar" (sea duck), "chuita," and "chiquitoy"; besides that of "patillo" (little duck).

Their flight is characteristic—low and straight. The appearance of intentness in flight is accentuated by the series of three conspicuous streaks in series; the orange and red bill, the white neck stripe, and the scarlet legs and feet lying straight back beneath the tail. The whole manner is that of one with predetermined course eagerly seeking a certain destination. I never saw one turn its head aside, as the swift gannet will do to investigate an observer. A very slight bend of the neck is sufficient for reconnoissance or for determining a change of course. Their short wings make flight a more strenuous and absorbing affair than for the gannet. Thus, as I have counted them, the wing strokes of the patillo, a minute, are from 250 to 300, as against 160 to 170 for the gannet, 150 to 190 for gulls of different species, and 140 to 150 for the pelican.

The home of the patillo is on the bold cliffs (pl. 65) and in the caverns, and the body color would give effective concealment against the rocky walls except for the brighter markings of the legs and the neck of the adults. As one approaches an apparently bare rocky wall rising above the surf, small bright red spots in pairs with three or four rays may be distinguished against the gray background of the rocks. If low down, they may easily be mistaken for star-fishes or the red-legged crabs left by the tide, but these are the legs and feet of the patillo. When one is a little closer a white spot is made out some distance above the red. The eye and the imagination may then fill out the form of the bird between the white neck stripes and the scarlet feet. The young birds against a rocky wall are almost indistinguishable even when one knows the exact location of the nest (pl. 65, fig. 2). When in flight, the bright skin colors and the neck

stripe, together with the characteristic manner of flight, makes this bird most easily recognized even at a great distance.

A surprising characteristic of the patillo is its cry, which is entirely unlike that of the ordinary cormorants that utter a coarse grunt or croak. When flying from the nest it often gives a high-pitched repeated chirp, somewhat like the note of the sparrow. This undoubtedly accounts for the common name sometimes used, "chuita," a name certainly more suggestive of a peewee than of a cormorant.

The nests are always isolated. Those examined were composed of a great variety of seaweeds, of many leathery worm tubes, of straw, feathers, and string, apparently any accessible and suitable material (pl. 65, fig. 1). One nest was weighed, although, unfortunately, more than a third of the material had been lost in removing it from the side of the cliff. The amount saved was found to weigh 8 pounds, and the complete nest must have weighed over 12 pounds. It was composed of *Ulva* and of various brown and red seaweeds, but the bulk of the total material was a chocolate brown weed with white tips, probably *Corallina chilensis*. The worm tubes, however, formed a very considerable portion, constituting $2\frac{3}{4}$ pounds or one-third of the material saved. These tough tubes, which bind together the looser materials to give strength and stability to the nest, must be of great value to birds that build, as the patillos do, such large and strong nests on almost any sort of a cliff where there is a bare foothold for the bird and the scantiest basis of support for the nest. Such tubes are, of course, taken only by diving, since the coast is free of exposed tidal flats.

The nests are frequently formed also deep in the caverns that undermine the walls of islands or mainland. The nests were found to have two or three eggs, but I did not happen to observe a nest with more than two young birds. The eggs are of very elongate oval form, pale blue, but smeared with a white coating unevenly distributed. Two eggs measured were respectively 6.3 cm by 3.8 cm, and 6.4 cm by 3.9 cm.

Tschudi [1] remarks on peculiarities of the coloration of the eye in this species, stating that the pupil of the eye of the patillo is sea green. I did not observe this, but my notes direct attention to the bright blue beading on the eyelids, 16 blue beads in all surrounding the eye.

The patillo (*P. gaimardi*), does not appear to extend very far north of Callao. It was never observed at the Lobos Islands of the north; in that region the *P. bougainvillei* is locally known as the "patillo." The name, "chiquitoy," applied in some localities to the

[1] On p. 314 of the Ornithologie, previously cited.

gaimardi, refers, I take it, to its small size among the cormorants. This cormorant has no appreciable economic value.

The three species of cormorants above described offer a striking illustration of the adaptability of nature. Three birds closely related, within the same genus in fact, dwelling in the same localities and not differing greatly in size, afford such striking contrasts in habits and appearance, as may be expressed in the following analysis.

Social habit.—The one herds in enormous flocks, another forms small groups, while the third is never seen except singly or in pairs. Of the two extremes, the patillo is always thought of as an individual, even though chance might bring several birds together, but the individuality of the guanay is always lost in the multitude.

Breeding habit.—The one nests crudely on the broad expanses of the island tops, another on the rough outlying rocks, while the third finds isolated homes on the cliffs or in the caverns where it constructs strong and secure nests of variously collected materials.

Feeding habit.—The one flies out in great flocks to swim on the surface and dive for prey in the schools of surface fishes: another watches from its low perches or dives down to capture the fishes of the bottoms near shore; while the third often makes long single flights before diving in search of eels or other fish or for nest-building materials.

Voice.—The one utters a distinctive croak, the second makes a harsh gutteral grunt, while the third has a high-pitched voice of the timbre of a song bird.

Color.—The guanay has a shiny black back and glossy white breast, the cuervo is dark and of almost uniform coloring, and the patillo is of generally variegated color with white stripes and scarlet feet.

The patillo (*P. gaimardi*) is rather remarkable among cormorants for the entire absence of any disposition to gregariousness, and it is the most specialized of the three in its well-developed habit of nest construction and its instinct of protection of young, shown in the choice of location for the home.

All of the Peruvian cormorants are smaller than the American *carbo*, but the guanay and the cuervo are about equal in size to the double-crested cormorant, the patillo being much smaller. The long bill of the guanay nearly equals that of *Phalacrocorax carbo*.

Specimens of the "patillo" weighed 2 7/8 to 3 1/8 pounds. The "cuervo" weighs 3 1/8 to 3 1/4 pounds, while the guanay has a weight of 4 1/2 pounds.

ECONOMIC IMPORTANCE OF THE CORMORANT.

The guanay (*Phalacrocorax bougainvillei*) is the only one of the cormorants having especial economic value, but this one outranks all the other birds of the coast in significance as a guano producer.

It well deserves the name by which it has probably been known since prehistoric times: "the guano bird" or *guanay*. Its gregarious habit, its choice of the level places or more gentle slopes on the tops of the islands for a nesting place, and its custom of remaining on the island a great part of the time, lead to the formation of enormous deposits with very little waste. In the light of the evident adaptation of this bird by its habits for the production of large deposits of guano, and in view of the significance of its native Peruvian name of *guanay* it is difficult to understand how the chief importance could have been ascribed to any other bird. Nevertheless, the principal credit has been variously assigned by previous observers to other species such as the piquero (gannet) and the penguin.

The guano of guanays is also found to have a very high value in nitrogen compounds, but whether this is due to the particular character of its food or to other conditions can not be stated. As far as my observations go, the guanay feeds almost exclusively on the anchobetas or other surface-swimming fishes. In the region where this bird was most abundant, that of the Chinchas and Ballestas, the climatic conditions were most favorable for the preservation of the nitrates. Even though my visits were made during the winter season—May, June, and July, when the season of *garua* (a sort of fog) was prevailing on the coast generally—the atmosphere on these islands was invariably clear and dry. It is doubtful if the guano of the Chincha and Ballestas Islands is ever wet from atmospheric moisture. Consequently the nitrates are not converted into ammonia, to be lost by evaporation or seepage.

Fourteen to seventeen per cent of nitrogen, or more, may regularly be found in the comparatively new guano, and there are many analyses of record to show that even the old buried guano of past centuries, when mined from these islands some years ago, yielded as high as 12 to 14 per cent, indicating practically perfect preservation. A sample of new guano which I took in June, 1907, yielded 17.65 per cent nitrogen when analyzed in September at the sugar experiment station near Lima, through the courtesy of Mr. T. F. Sedgewick. A second sample from the same place kept in Callao, and analyzed in the following April by Mr. H. H. Bunting, showed 15.91 per cent nitrogen, while a third portion brought to the United States and analyzed in March, 1909, by the United States Bureau of Chemistry, contained only 8 per cent nitrogen—showing the marked deterioration from the effect of atmospheric conditions. Generally, as the nitrogen is lost in guano, the relative proportion of phosphatic compounds increases, but this means great loss in value, since phosphatic guanos have little value in comparison with nitrogenous or characteristically "Peruvian" guano. It is due to the rarest climatic conditions that the millions of tons of guano deposited during the previous times should have retained its nitrogen.

One may easily appreciate what enormous value such flocks of birds may have. A single ounce of permanent guano for each bird deposited each day, with a flock averaging 500,000 birds, would represent 15½ tons of guano a day, or 5,700 tons a year. During the period of my stay in Peru the south island of the Chinchas was kept permanently "closed." No guano extraction was allowed by the Government, and the birds were undisturbed; this island was visited after one, and again after two years of closure. On the occasion of the latter visit it was estimated that between 12,000 and 15,000 tons had accumulated, and it was confidently predicted that at the expiration of the third year the recent deposit would amount to not less than 20,000 tons. These estimates were based on measurements of the thickness and the area of the deposits. Twenty-six measurements of thickness after 20 months closure showed an average depth of 18.5 cm., or 7.4 inches, indicating an anuual deposit of 11.1 cm., or 4½ inches, the weight of which would be about 300 pounds a square meter. Meantime, however, owing to the fortunate protection extended the birds by the enforced closure, the flock seemed to gain steadily in size. After closure for three years and four months, from November, 1906, to March 1, 1910, the island was reopened, and the published report [1] shows that 23,512 toneladas were taken from that island by the Compañía Administradora del Guano (22,337 English short tons, or 21,631 metric tons).

Guano of this high grade in nitrogen content rarely reaches the United States. For purposes of appraisal, however, it may be said that such guano, if purchased on the islands at $40 a ton, brought to the United States, and sold at prewar prices, would have yielded a substantial profit after defraying all expenses. Consequently the value of the guano deposited by this single flock during a period of a little more than three years may be stated at nearly $1,000,000. To quote from a previous report of mine:[2]

> From the various calculations I have made it appears that a rookery will yield about 1 long ton of guano per year for 28 nests. Twenty-eight nests or 28 pairs of birds have an annual producing value of $40 net. We give a fair idea of the commercial significance of these birds to Peru when we say that each brace of birds contributes annually $1.43 worth of guano, besides leaving a pair of offspring to continue its service. Is it not, then, of the greatest importance that the fullest protection should be extended the birds, and every possible precaution taken to insure that there may be the maximum number of birds at every rookery, and that these birds may remain upon the rookery the maximum amount of time? [Page 359.]

Fowl which produce $1.43 worth of guano a pair annually, without expense for care and feeding except the minimal cost of protection, may well be appraised at $15 a pair. The fowl which dwelt on the South Chincha Island alone, when it was visited in 1907, might well

[1] Compañia Administradora del Guano, Limitada. La memoria del directoria. Lima, 1910. [p. 21.]

[2] The fisheries and the guano industry of Peru. Bulletin of the Bureau of Fisheries for 1908, vol. 28. 1910. pp. 333-365.

be regarded as an asset representing a value of several millions of dollars.

Nor is this the only flock, although the principal one of the coast. Other important flocks were noted at the Lobos de Tierra Islands of the North, at Asia, Pachacamac, and other places, besides the neighboring flocks at the Ballestas Islands, and on outlying rocks. There were four or five small islets about the North Chincha Island, each with something like 1,000 guanays. In 1907 the Ballestas North, Middle, and South Islands, respectively, yielded about 500, 800, and 900 tons of high-grade guano.

When first deposited the guano is wet and sloppy, but under the baking sun this forms a hard thick cake, in color gray, which can be broken with an axe or a pick. As the deposits of later years accumulate, the lower layers undergo a change, becoming finely pulverized, so that old buried guano can be scooped with a shovel. The old or mineral guano may be of various colors, red, brown, almost black, or light gray, or even green, due in part to chemical changes, in part to foreign substances mixed in. When exposed to the sun, the old guano sometimes acquires a thin crisp whitish crust. Walking over this may give the sound of walking on the icy crust of snow. The old guano does not, however, always bleach white.

Into the formation of such deposits go not only the excrement but all offal matter, such as waste food, dead bodies of young and old birds, and unhatched eggs—all may be finally blended into one apparently undifferentiated mass.

It is related that one of the islands of the Chincha group was reduced 100 feet in height by the extraction of the deep crown of guano deposited during past centuries. The story is by no means incredible, since, if the flocks of birds of the South Chincha Island could have remained undisturbed and continued breeding in the same place, the top of the island would certainly have been raised a hundred feet in about four centuries. The wonder is not how came the deposits of tens of millions of tons, but what became of the other millions which must have formed during past ages but which are not accounted for by the records of extraction. How much must have been lost by wasting into the sea!

There are given below the analyses of several samples of recent guano of guanays from the Ballestas Islands, showing an extremely high value in each case:

	Moisture.	Sand.	Organic matter.	Phosphoric acid.	Alkalies, etc.	Containing nitrogen.	Equal to ammonia.
1	20.26	0.75	56.59	8.89	13.51	15.91	19.32
2				12.35		17.65	
3	19.77	1.35	54.23	10.35		15.40	
4	19.95	2.20	54.10	10.36		14.95	
5	19.80	1.60	51.80	10.48		14.58	
6	18.20	3.60	51.15	11.19		14.41	
7	21	2.10	51	10.66		14.33	

These analyses were made for me, severally, by Mr. H. H. Bunting, F. C. S., Oficina de Ensayes of the Peruvian Corporation (Ltd.), in Callao, and by Señor P. G. Ureña, of the Estacion Experimental para Cana de Azucar, near Lima (through the courtesy of Mr. Thomas F. Sedgewick, director of the station).

THE PELICANS.

According to report, the pelicans are represented on the Peruvian coast by two species, but the common one and the only one that I observed was *Pelecanus thagus* Molina. It is one of the largest representatives of the pelican family, its measurements being distinctly greater than those of the American white pelican and much greater than those of the common American brown pelican. Taczanowski records *Pelecanus fuscus* Linnaeus as collected by Captain Markham at Payta. I have a copy of Taczanowski's *"Ornithologie,"* formerly in the possession of Doctor Nation of Lima, in which is a penciled entry noting its occurrence at Lima.

PELECANUS THAGUS Molina.

THE PELICAN OR "ALCATRAZ."

The alcatraz is common on the entire Peruvian coast. I observed it from Tumbes in the north to Mollendo in the south. During the period of my stay on the coast it was present in much greater numbers in the northern region than in the south, but this was doubtless attributable to temporary conditions which, as will appear later, afforded the bird better protection for nesting on the larger islands of the north.[1]

The description of the species as given by Molina, or by Taczanowski, need not be repeated here. There are, however, a variety of color phases to baffle the observer at first, as may in part appear from the photographs. Some of the color phases of the young are mentioned later. The typical coloring during the period of incubation (pls. 66 and 67 and pl. 68, fig. 2) comprises a white forehead and neck stripe, dark brown neck and back, upper sides of wings more or less variegated. The nuptial plumage, as I take it, preceding this stage is characterized by yellow in place of the white on head and neck. The older birds become more and more white, especially on the head and wings. Some are found that have the back and belly and neck gray, and the head all white (pl. 68, fig. 1) while birds that I presumed to be the oldest, were almost entirely white on back and

[1] I suspected that the pelicans of the southern portion of the coast of Peru had migrated to still more southerly latitudes. Captain Jefferson of the Chilean steamship line said to me in 1907 that vast numbers of pelicans were observed at islands along the coast of Chile in higher southern latitudes than he had been accustomed to see them.

wings, the belly being brownish and the head and neck all white.[1] A variety of color phases have been fully described by Forbes,[2] who does not attempt to interpret their sequence in life history.

Forbes, in the paper cited, gives an interesting account of the habits of the pelicans. The observations which I offer here are generally supplemental to his account.

Pelicans, whether breeding or not, spend a great deal of time on the islands and are commonly seen standing in solemn ranks on some hillside or on a point of land commanding the ocean. They are more timid than most of the other birds, so that one may not approach them readily. Particularly in the morning, they delight to find some quiet little cove where they bathe and splash in the water. They make long flights on the ocean, flying in long files with slow wing strokes. The comparatively slow movement of the large wings gives a false appearance of leisureliness to the flight, for it was observed that they were rarely passed by the more "swift-winged" birds of smaller size. They not infrequently float on the water while waiting for food or resting between meals. The pelican shows ease and grace of movement only in flight—the dive for fish has an appearance of awkwardness and causes a great splash. The bird does not appear to go under water, the heavy coat of feathers probably making this impossible. With its long neck and bill fish may, however, be reached several feet beneath the surface. They may devour even large fish; at one nest I found a regurgitated mullet or "liza" (*Mugil cephalus* Linneaus) over a foot in length. The anchobetas (*Engraulis ringens* Jenyns) con-

[1] The following is an account of the color changes as far as I could make them out, by inference from observation of the group, without the opportunity to trace the history of individual birds. With this qualifying statement, I give them for what they may be worth in suggestion to other observers.

(*A*) The immature bird after leaving the nest is brown with white breast, some buff on the upper side of wings. Head and neck brown and without lateral stripe. Bill green at base and top, sides orange. Pouch orange yellow (pl. 69).

(*B*) Nuptial plumage: The feathers of head and neck stripe are yellow; the "cravat," or necklace of yellow, is formed, while the rest of the neck is a very dark brown, almost black. The covering of striate feathers on the back and lower side develops, while the mantle of pearly gray completes the nuptial plumage. The pouch becomes black with blue stripes on the sides anteriorly and the characteristic red appears on the generally greenish bill. This phase was observed in birds occupying new-made nests and often in outlying rookeries. No adults of this phase were found on nests where the eggs had hatched out.

(*C*) After the beginning of the laying, the yellow feathers are shed and replaced by white, which, however, do not extend so far into the crest nor are so long as the yellow. A "cravat" of greater or less size may be retained or may be lost entirely. Many of the birds in the nests had heads partly yellow and partly white. The longer yellow feathers being in patches of greater or less size amid the shorter crop of whites. The changes do not always occur in just the same order. Thus whitehead birds may still show some white feathers in the lower side of body.

(*D*) Another phase may be described, but whether it represents a possible stage between (*B*) and (*C*), or an older stage than (*C*), or is a phase peculiar to one sex, I am unable to say. Birds in this phase were observed to be brooding. The head and neck stripes are light gray, the neck is soft gray, the upper parts are generally brown, but a small region of back and breast around the base of the neck has the typical white and dark brown striate feathers; the breast is generally white mottled with brown feathers having a white median stripe; the bill is red and yellow, the pouch as in (*C*) but paler. This phase includes some features of the immature (*A*), and some of the typical brooder (*C*), but the gray neck is characteristic.

[2] Forbes, Henry O. Notes on Molina's Pelican (*Pelecanus thagus*). The Ibis. Tenth Series. Vol. 2, No. 3. London, July, 1914, pp. 403–420.

stitute a considerable proportion of the food of pelicans as of the other sea fowl.

The nests are made on the level ground or on gentle slopes and generally in large aggregations (pl. 66). After the rookery at the Lobos de Afuera Island was broken up in 1907, many smaller rookeries were found in the following season (Dec., 1907), in addition to one or two that were some acres in extent. Some of these rookeries were connected in a curious rambling way (pl. 67). The nests are less regularly spaced than those of the guanays and naturally are much farther apart; while the guanays average 3 nests to the square meter, the pelican will average only about 2 to the square meter.

The behavior of pelicans on the nesting grounds in some respects appears stupid and inexplicable. An alcatraz on her nest will sometimes reach over with her long neck and bill, take a fledgling from the uncovered nest of a neighbor and throw it away, perhaps into another nest. Once, within a space of 2 square meters, I saw six little "pichones," almost new born, bandied about in a most merciless way, tossed from one alcatraz to another, each seemingly unwilling to have the little birds in their proximity. Finally three of the fledglings were thrown beyond the margin of the nesting ground and left to die in the sun. I watched a pelican that returned to a nest from which the only fledgling had been transferred by a mischievous neighbor into an adjoining nest. The returning brooder did not appear to notice the loss, but sat composedly on the remaining egg; then, pilfering on her own account, she quietly reached over and stole all of the feathers from the nest in which lay her own offspring (supposedly) among others, to add to the lining of her nest. I questioned if the birds invariably occupied the same nest; on one occasion, at least, a bird was seen to brood on two different nests. The birds near the margin had been frightened away, but, most of them returning, all of the nests were soon reoccupied except the ones nearest to me. An alcatraz, after sitting for 15 minutes on one nest, moved slowly over to another nearer to me, while its place on the first nest was at once taken by a bird that was previously covering an empty nest. The young were trampled dangerously by the old birds as they moved awkwardly about. Perhaps these are abnormal actions, attributable to nervousness caused by the presence of an intruder.

I never found any considerable number of nests uncovered but once, when I came on a small rookery of some 100 to 200 nests, where there were only a dozen birds. Returning after an hour or less I found the same condition. Supposing the ground abandoned, I opened some eggs from different nests, finding live embryos in all. The eggs remained warm under the midday sun. Doubtless the insect parasites which swarm on the nesting grounds would occa-

sionally compel the brooding birds to seek the shores to rid themselves of the pests, as far as possible, by splashing in the water.

Birds are often seen coming to the nests with feathers between the jaws, or with pouch hanging low with small feathers or trash, which is ejected with some difficulty and deposited by the side of the mate to add to the lining of the nest.

The nests, as observed, were shallow and roughly lined with feathers and usually contained many small rocks. They contain a variable number of eggs—from 1 to 8; 3 is the most common number. Of 207 nests counted 35 contained 1 egg; 73 contained 2 eggs; 84 contained 3 eggs; 10 contained 4 eggs; 4 contained 5 eggs; 1 contained 6 eggs.

Most of these were not new nests, so that the number of eggs was probably permanent, barring accident or intrusion. In looking over a large number of nests I saw two with 8 eggs each; from one of these the eggs were opened and all contained live embryos of approximately the same size. A number of nests with 6 eggs were seen, while 5 was a very common number. Four nests, each with 1 egg apparently old, were marked; 6 days later, they were as at first. Three nests, each with 1 white (new-laid) egg, were marked (Nov. 29); 2 days later they were unchanged, but after 6 days one had 3, another still one, and the third was empty. Of 7 other nests marked, one with 2 white eggs gained 1, while 1 with 3 eggs lost all. Loss of eggs may occur from the depredations of the gulls or gallinazos (turkey vultures); from the awkwardness of the parents causing eggs to be thrown from the nest when the birds start in flight; and, doubtless too, from pilfering by stray cats that, unfortunately, infest the island.

The eggs when new-laid are pure white in color, but soon become so soiled with guano as not to appear white at all. The form is variable, and the ends are sometimes almost equal. The size is about 82 mm. in length by 56 in transverse diameter and a little less than 5 ounces in weight. The length of 10 taken at random was from 76 to 97 mm.; transverse diameter, from 53 to 62; weight, 4 to 7 ounces, as shown by the following table. The egg of 97 mm. in length and weight 7 ounces was a very exceptional one.

Dimensions and weight of 10 eggs of Pelecanus thagus, Lobos de Afuera.

Specimen.	Length.	Transverse diameter.	Weight.	Specimen.	Length.	Transverse diameter.	Weight.
	Millimeters.	*Millimeters.*	*Ounces.*		*Millimeters.*	*Millimeters.*	*Ounces.*
1	82	55	4.5	6	80	55	4.5
2	80	55	5.0	7	78	56	4.5
3	79	55	5.0	8	97	62	7
4	86	58	5.5	9	76	55	4
5	80	53	4.0	10	78	58	4.5

The average of these measurements is 79.9 by 55.6. Forbes found an average of 83.7 by 55.7.

The young birds are bare of feathers, and, as I observed them at the Lobos islands, with black, dark blue or purple skins, but Forbes says[1] they "are of a pale flesh-color, thus differing markedly from those of the brown pelican (*P. fuscus*) which, according to Chapman, are livid black." They are of some size before the white downy covering is acquired. The birds are nearly full grown before the first feathering appears on the wings and back. (See pl. 68, fig. 2, showing an old bird and young in several stages.) The young about this time seem to be substantially larger than the adults in almost all dimensions.[2] A young bird just attaining the stage of flight from the nest is shown in the illustrations (on plate 69). The very dark brown or fuscous coloring of head, neck, back, and sides is conspicuous. The rump is lighter in color while the belly is nearly white. There is yet no sign of the white forehead and neck stripe of the adult. This bird was kept as a pet for several weeks.

The season of nesting is almost uninterrupted, though less active during the winter months of May to September. In March and April, 1907, the rookeries at Lobos de Afuera contained thousands of eggs and young in all stages. On June 18 of the same year, young nestlings just beginning to feather were observed on an islet near the North Chincha Island. The Lobos de Afuera islands were again visited in December, when the large rookeries were filled with eggs and very young nestlings.

In the south the only active rookeries noted were on two islets near the North Chincha Island; although numerous evidences of abandoned pelican rookeries were observed on various islands of the Chincha and Ballestas groups, on San Gallan, and on the Santa Rosa Islands at the Bay of Independencia. At the latter place, I was informed by a fisherman that, a few years before, a guano extractor, finding the young pelicans in the way, had herded them and driven them over the cliff. Examinations of the beach at the base of the cliff revealed thousands of skeletons of young pelicans with other débris.

In the autumn of 1907 (March), at Lobos de Afuera, a rookery many acres in extent (pl. 63, fig. 1) occupied the northern point of the eastward island, and a small islet to the north of it. It was estimated that there were about 100,000 birds. During the following winter this was entirely broken up by the extraction of guano. At the beginning of the next summer (December) there were numerous (six or more) small rookeries scattered over this island and containing in all about 2,000 nests;

[1] Forbes, Henry O. Notes on Molina's Pelican (*Pelecanus thagus*). The Ibis, ser. 10, vol. 2, No. 3, London, July, 1914, pp. 403–420 [p. 416].

[2] The grown young are normally somewhat heavier. Several fully mature pelicans weighed 12–14 pounds, a very old and thin bird weighing only 9¼ pounds. A young specimen had a weight of 16 pounds.

but the majority of the birds were occupying the westward island, which had not been disturbed. Here, too, were many scattered rookeries, some with birds in small groups, others with nests arranged in long rambling ranks (pl. 67). At the end of the land, however, and connected with the last-mentioned series, there was a large rookery including probably 6,000 nests (pl. 66). It was estimated that there were between 10,000 and 20,000 nests on the group of islands. A great many of the birds had apparently removed to the Lobos de Tierra Islands, a few miles to the north.

The change of conditions noted in successive seasons on the Lobos Islands as regards the nesting of pelicans, was only one of many evidences that this species is not easily reconciled to disturbances. The adult pelican will often stand by its young, but the radical disturbance of its nesting ground, as by removal of the guano, seems to be the signal for a change of location in the following season. The pelican is, indeed, relatively timid and clannish by nature. Its nesting grounds were never observed in close proximity to those of other birds.[1] It was noted also that the rookeries were generally well removed from the loberias (or rookeries of sea lions), though this may have been due to chance.

Pelicans are more infested with insect pests than any other of the guano birds. The neighborhood of the nests is, therefore, a most unpleasant place to stand for any length of time. One of these (a Mallophaga?) is abundant all over the ground; it crawls up the legs, body, and neck of the bird to find an attachment within the pouch, where it may always be seen in scores. The great bills are quite helpless against such pests, and the only defense seems to be in the daily baths which the pelicans take in convenient coves.

Other enemies of the pelicans are the gulls and "gallinazos," whose depredations will be described in the account of the gallinazos (p. 498). Cats undoubtedly prey upon the young. It is interesting that cats, which have escaped from the guano workers' or fishermen's camps should have established themselves upon the Lobos Islands, where there is no possible source of fresh water, although an abundance of bird and fish food is to be found in the rookeries and on the beaches. The extermination of these cats is strongly to be recommended, and the conveyance of cats to the islands should be prohibited.

Still another enemy of the pelican is the abundant "lobo," or sea lion, although I can not rate highly the damage done by it. I wit-

[1] On the other hand, Forbes, from observations at the Chincha Islands when pelicans and cormorants had just returned after a remarkable and unexplained absence of a year, found the nesting pelicans "crowded together in large colonies, very generally surrounded by still denser and more extensive colonies of *Phalacrocorax bougainvillei*." He adds: "At this season the birds are extremely timid and rarely allow the near approach of an intruder without taking wing with a recriminating 'wauk' from their nest; in this respect they are unlike their incubating friendly neighbors, the cormorants, which allow one to come comparatively close to them without leaving the nest." (Forbes, The Ibis, vol. 2, 1914, p. 415).

nessed the successful capture of a pelican by a sea lion, as is elsewhere described, and, at another time, found the floating body of a pelican which had evidently been destroyed in the same way. Such mutilated bodies are said to be found occasionally on the beaches. However, unless a pelican were hampered by previous injury or weakness, it is not often that a "lobo" could make a successful capture. A young pelican which I kept in confinement was sometimes allowed to swim in the water when large sharks were near. It was very successful in detecting the approach of a shark, and would fly from place to place as far as the line permitted, while followed by the shark. The fear of the animal was probably founded upon a real danger, but at the same time served to protect the bird from actual capture. It was observed that when a school of anchobetas appeared, breaking the surface of the water for acres, the pelicans and gannets would not always plunge into it at once, but would first circle about for several minutes, and it was presumed that this was done in order to reconnoiter for the detection of dangerous enemies. The question of the damage done by the lobos is of especial interest, since the extermination of these forms has been suggested. All the evidence and many observations in relation to this question have been fully discussed in a previous report where it was recommended that the sea lion be utilized as an asset, but not treated as a subject for extermination.

The chief enemy of the pelican in modern times is man. Many birds have been killed for the feathers, of which the pelican possesses a very thick coat. At Pacasmayo I was told on reliable authority that many fishermen and guano laborers went out to the islands with straw mattresses and returned with feather beds. The eggs of guano birds have in past times been taken in vast numbers partly for food, but more especially for the use of the albumen in the clarifying of wines. Such ruthless destruction is forbidden by the Government, and has been practically stopped. However, about 1907, a boat that was captured by a Government cutter, was found to be carrying nearly 20,000 eggs.

The serious decline of the pelican flocks is, I am sure, to be attributed more particularly to the disturbance of the rookeries in the extraction of guano, as will be discussed below in the consideration of the economic significance of the pelicans as producers of commercial guano.

ECONOMIC IMPORTANCE OF THE PELICAN.

The pelican is actually one of the two most important guano birds of the coast, but its value is undoubtedly far less at the present time than in the past. Two considerations should be kept in mind. The importance of the guano production depends not only upon the abundance of the birds, but also in great part upon the latitude of the islands selected as breeding grounds. The latter consideration has not been

given adequate consideration in connection with the protection of birds. As previously indicated, ideal conditions prevail in the region of the Chincha Islands, but not to a like extent in the north. Rain, indeed, is very rare on the Lobos Islands,[1] but the humidity there is much higher, so that a considerable proportion of the nitrogen of the guano escapes in the form of ammonia. Consequently no Lobos Island guano is of the high quality of the Chincha guano, and this difference is not due solely to the difference of the species of birds acting as chief producers. As a matter of fact, the freshly made guano of the pelican may be very high in nitrogen. Analysis of pelican guano, taken from a cage in which I kept a pelican, and bottled the same day as deposited (but after allowing to dry), showed a nitrogen content of 21.66, with phosphoric acid in amount 4.30; while a sample taken from the surface of the rookery on the same island (Lobos de Afuera) analyzed only 8.41 nitrogen and 17.40 phosphoric acid. Comparison of guano cake from the rookery of guanays in the Chincha region shows 15.91 per cent of nitrogen and 8.89 per cent phosphoric acid.[2] Of course it is primarily the nitrogen that determines the value of this fertilizer. The difference in percentages of nitrogen in the cage and rookery guanos is not to be attributed solely to atmospheric conditions, but is accounted for partly by the foreign materials which pelicans introduce on the nesting grounds in much greater degree than do the guanays, all of which add to the bulk with less proportionate addition to the value of the guano. The complete analyses show, however, that the fresh unmixed pelican guano and the guanay rookery guano (Ballestas Islands) have nitrogen constituting more than a fourth of the organic matter (26 and 28 per cent, respectively), while the guano from the pelican rookery (Lobos de Afuera) shows nitrogen as less than one-fifth of the organic matter (19 per cent).

[1] That rain has occurred on the Lobos de Tierra Islands was evidenced by the signs of comparatively recent erosion. Some very distinct, though small, water channels were noticed on some of the hills. I was told by the fishermen that a light rain had fallen two years previously.

[2] The complete analyses are as follows:

	Pure guano of pelicans from cage.	Guano of pelicans from rookery, Lobos de Afuera.	Guano of guanay from rookery, Ballestas Islands.
Moisture	9.40	16.14	20.26
Sand	.85	9.10	.75
Organic matter (a)	81.75	43.86	56.59
Phosphoric acid (b)	4.30	17.40	8.89
Alkalies, etc	3.70	13.50	13.51
	100.00	100.00	100.00
(a) Containing nitrogen	21.66	8.41	15.91
Equal to ammonia	26.30	10.21	19.32
(b) Equal to tricalcic phosphate	9.38	37.98	19.41

Analyses by Mr. H. H. Bunting, F. C. S., of Callao.

The fact is that guano of the Chincha region is richer than guano from the Lobos Islands when extracted. Paraphrasing a good proverb, and speaking from the commercial point of view, a pelican in the south is worth two in the north.

The southern climatic conditions are believed to be adapted to the pelican equally as well as the condition in the north. The preference of the pelicans for the Lobos Islands at the period of my visit is easily susceptible of explanation. As long as guano extraction is carried on regularly on all of the islands, with consequent disturbance of the breeding grounds, the pelicans will naturally confine themselves to the outlying rocks, or to the larger islands (such as the Lobos Islands), where it is possible to take up new ground at a distance from the scene of commercial work. It was a matter of observation that the pelicans occupied a few outlying and rather inaccessible rocks near the Chincha Islands and the large Lobos Islands in the north, together with some outlying rocks in that region. There were, however, the most direct evidences that pelican rookeries had existed on the Chincha, Ballestas, and Santa Rosas Islands, as well as on San Gallan. Finally, there are entirely reliable statements that pelicans were formerly exceeding abundant in the Chincha region.

It was attempted to learn what amount of food the pelicans would consume in a day and what the daily production of guano was, but the experiments were not very satisfactory, owing to the fact that in confinement the birds would refuse to eat for several days. Each of two birds produced about half an ounce of guano in the first night of captivity. One of them, after fasting for six days, consumed 4 pounds of fish in one day, but later refused to eat and appeared so unwell that it was liberated. The experiment could probably be readily carried out with an immature but grown pelican.

On one island occupied by pelicans the deposit was 17 cm. thick at the thickest part, and I was told that the island had been left clean at the end of the preceding season. The islet covered about 1,225 square meters, but, as the guano was very thin in some places, the total yield was only about 125 tons. With a uniform thickness of 17 cm. such an area should have yielded a little more than 200 tons. The odor suggested a high nitrogen content.

THE MAN-O'-WAR BIRD OR "TIJERETA."

The common name, "tijereta" (meaning "scissors"), as applied by the Peruvians to the man-o'-war bird, *Fregata*, sp., is aptly descriptive of its sharply-forked tail which opens and closes in flight. It is scarcely a common bird of the region of the guano islands, having a more tropical habit. Nevertheless, they are not infrequently seen about the northern islands either soaring in lofty flight or descending to pursue the gulls or gannets. When the harassed

birds disgorge their prey in self-defense, the tijereta with swift flight will recapture it in mid-air or snatch it from the surface of the water. In one instance I have seen the table almost turned when a large gannet (*Sula nebouxi*) pursued a tijereta back and forth for a considerable time. A turn of the tijereta from time to time would put the gannet to temporary flight. The end of the combat was not witnessed.

Stolzmann, as quoted by Taczanowski,[1] says:

> The Peruvian port of Payta is the southern limit of geographic distribution of this bird on the Pacific Ocean. It is astonishing that it is found on the Atlantic as far as Rio Janeiro, 23° S. latitude, while on the Pacific it does not pass the 5° of S. latitude.

Undoubtedly the colder waters of the west coast are not favorable to an extended range, but my records indicate a more southerly range than is stated by Stolzmann. The tijereta was observed at Tumbes (3½° S.) in January, 1908; at Paita (5° S.) in April, 1907; at Lobos de Tierra (6½° S.) same month; at Eten (7° S.) in November, 1907; and at Pacasmayo (7½° S.) in March, 1907. At Eten nine specimens at one time were seen in flight inland from the village, and a little later some six or seven more were observed. Only one example was noted at Pacasmayo, but a reliable local informant at that place spoke of it as an occasional visitor.

The mangrove-bordered estuaries of Tumbes in the far north of Peru undoubtedly constitute its most southerly nesting place. In January, 1908, their nests were seen in abundance on the mangrove trees, as had previously been described by Stolzmann.

Von Tschudi mentions the red-billed tropic bird, *Phaethon aethereus* Linnaeus, as occurring on the Peruvian coast and states that the Snakebird, *Anhinga* (*Plotus*) *anhinga* (Linnaeus), nests on the islands of the coast. The latter is mentioned as one of the important guano birds. Neither of these was observed on or near the islands.

THE SHORE BIRDS (LIMICOLAE).

While the Limicolae, or shore birds, are well represented in favorable regions on the mainland, they do not in any abundance frequent the Peruvian Islands with their generally rocky shores. The islands of Lobos de Afuera and especially Lobos de Tierra offer more favorable beaches than any of the others, although some of the shore birds may be met on almost any of the island groups. No extensive collections of birds of this order were made, but the species collected and identified are mentioned in the following paragraphs.

The oyster catcher or "brujillo de pecho blanco" (little witch with white breast), *Haematopus palliatus* (*brasilianus* Maximillian?), was recorded in my notes at the Chincha Islands, Chilca Bay, and the Isla Vieja. With its distinctive cry and striking color markings, the

[1] Ornithologie du Pérou, p. 428.

white-breast brujillo is unmistakable, whether in the air or on the land. In flight the conspicuous white band on the upper surface of the wing, the white breast, the almost black head, and bright red bill directed downward and continually opening and closing, makes this bird as conspicuous as does its shrill excited cry. While on the ground they usually make a single isolated call, but when flying high-pitched cries are uttered almost incessantly. On one occasion, in the little Bay of Chilca, about a dozen of these birds in a group on the shore, becoming excited from some cause, fairly filled the small amphitheater with their shrill voices. This was an unusual aggregation, for I rarely observed them except in pairs, whether at rest or in flight.

A female, taken at the Chincha Islands in June, had only very minute eggs in the ovary. In a female taken at Asia in the latter part of August the eggs were 3 to 4 millimeters in diameter. Stomach examinations revealed small pebbles, pieces of crustacea (*Hippa*, etc.), pieces of shell, opercula of gastropods, and mussel shells. A specimen taken at Chincha had a weight of 1¾ pounds.

The black oyster bird, or "brujillo" (*Haematopus quoyi* Brabourne and Chubb), was more commonly observed than the other. It was noted at the Chincha Islands, Chilca Bay, Asia Island, the Bay of Independencia, Paracas Bay, and Lobos de Tierra.

The curlew or "sarapico" *Numenius hudsonicus* (Latham), is not infrequent on the islands, and, of course, is quite commonly found on the mainland about small lakes or rivers. They frequent the available beaches of the islands, singly, in couples, or in small flocks, and at a little distance are barely distinguishable against the sandy beach. They have a high-pitched excited cry when flying. The stomach contents of two specimens examined were exclusively portions of *Hippa*, the common "mui-muis" of the sand beaches. In these examples the eggs were small, about 1 millimeter in diameter (Chincha Islands, June 14, 1907, and Chilca, Aug. 27, 1907).

The small beach birds, sandpipers, plovers, etc., were observed rather abundantly at Lobos de Tierra in December, 1910, and they were not uncommon at Lobos de Afuera about the same time. The following specimens were taken:

Arenaria interpres (Linnaeus), Asia Island, August 26, 1907. Common name: "Til-Til."

Arenaria interpres (Linnaeus), Lobos de Afuera, December 3, 1907. Common name: "Til-Til."

Heteroscelus incanus (Gmelin), Lobos de Tierra, December 13, 1907. Common name: "Til-Til."

Calidris leucophea (Pallas), Lobos de Tierra, December 10, 1907. Common name: "Til-Til blanco."

Aegialitis nivosa (Cassin), Paracas Bay, June 29, 1907. Common name: "Chinita."

Aegialitis nivosa (Cassin), Paracas Bay, June 29, 1907. Common name: "Cajero."

Ereunetes pusillus mauri Cabanis, Lobos de Tierra, December 13, 1907. Common name: "Til-Til."

THE CONDOR.

None of the vultures are significant guano producers, yet they are found on the islands, and at least one of the species is an important factor in the bionomics of the island.

The large condor, or "buitri" (*Vultur gryphus* Linnaeus), "the king of the vultures," is not uncommon in the higher hills and mountains of the interior of Peru and visits the coast to feed upon the animal matter cast up on the beaches (D'Orbigny).[1] It is reputed by the natives to prey sometimes upon the nestlings of guano birds, but such depredations were not observed. Individual birds, evidently of this species, were not infrequently seen resting on a hillside or on some high ledge of the islands south of Callao, as at Santa Rosa, San Gallan, the Ballestas Islands, and Isla Asia. Doubtless the condor frequents islands north of Callao; but my visits to islands of the northern region were principally to Lobos de Afuera and Lobos de Tierra, which are, respectively, 10 and 35 miles from the main shore. According to my native guides at these points the condor is never seen on these islands.

D'Orbigny states that the wing spread of this condor does not exceed 3 meters and that the ordinary length is above 1¼ meters.

In this connection it may be mentioned that the true king vulture, *Sarcoramphus papa* (Linnaeus), which, according to D'Orbigny, is not half so common as the condor, and is confined to the eastern side of the Andes, has been recorded by Stolzmann from the west coast between Tumbes and Lechugal.[2]

Condors are undoubtedly becoming rare, while the vultures mentioned below increase with the spread of human habitation. The rapacious condors are pursued, while the harmless vultures are, in a measure, protected for their service as scavengers.

THE VULTURES OR "GALLINAZOS."

The "turkey vultures," or "turkey buzzards" ("gallinazos" they are called in Peru), are not only among the most common birds seen about the towns and villages, but are found on any island inhabited by other birds or by sea lions. The commoner species near the cities

[1] Taczanowski. Ornithologie du Pérou, vol. 1, p. 75ff.

[2] Idem, vol. 1, p. 81ff.

is the black vulture, "urubu," or "gallinazo de cabeza negra" ("gallinazo of the black head"), *Coragyps foetens*, which undoubtedly renders most useful service where the scavenger work is otherwise too little provided for. With them is found the red-headed gallinazo (*Cathartes aura*), which renders similar good service, but which is less numerous and, according to report, more timid in its nature.

The latter species is common on the islands, whither it is attracted by the excellent opportunities for feeding afforded not only on the beaches but on the rookeries of birds and of sea lions. On the islands, indeed, it is at least questionable whether its beneficial services as a scavenger outweigh the detriment that it works by its depredations upon the nests of the birds of more direct importance. The gallinazos are always to be seen about the loberias or homes of the sea lions, and in the rookeries of pelicans, gannets, and cormorants. Their diet is not restricted to refuse of the beach and dead bodies of birds and sea lions they may find occasionally on the higher ground; whenever the opportunity occurs they will snatch the eggs from the nests or devour even the young fledglings. Any visitor may make such observations, since the presence of an observer, causing the birds to fly temporarily from their nests, gives a most convenient opportunity for the gallinazos to commit their depredations. That they do not have to wait for such an unusual occurrence was shown by the repeated observation of two or more gallinazos or gaviotas working together to despoil the nest of a piquero; while the anxious parent is occupied in driving the intruders away, the other gallinazos or gaviotas seize the opportunity to rob the uncovered nest of eggs or nestlings. Perhaps this cooperative assault is not the result of definite plan, yet it seems quite clear that when the attack is initiated by one bird the others recognize that the result will bring a desired opportunity and prepare to avail themselves of it. At other times they snatch the opportunity to feed upon the fish brought by the parent to feed the young but for some reason prematurely disgorged; the offended bird contests with the intruder for the fish, but the latter is usually successful in getting a large share.

While the gallinazos render some service in the rookeries by consuming the waste food and the bodies of fowls which may die at the nest, yet in the dry atmosphere of the islands, where the sun shines every day, it is doubtful if such bodies would accomplish much injury. The result of the atmospheric and soil conditions, at least on some of the islands, is such as to preserve the dead bodies. I have observed on the Chincha Islands the exhumed bodies of men who, having died in service on the islands, have been buried in the guano or sand. These bodies, disinterred in time by the removal of more guano, seemed almost perfectly preserved.

Nests of the gallinazos were observed in the islands of Lobos de Afuera and Lobos de Tierra. In December, 1907, three nests of the *aura* were found, one in a cave on the hillside, another under a small overhanging ledge of rock (pl. 53, fig. 3), and a third in a narrow deep cave just above the water line on the beach. In the first case, as the bird flew from the nest it emitted a brownish vomit, which created an unendurable stench. Scarcely any effort seemed to have been made to form a nest. The eggs are slightly yellowish white, spotted and blotched with reddish brown, and little reduced at the smaller end. The measurement of two eggs from one nest were 72 by 50 mm. and 74 by 50 mm., and of two from another nest, 71 by 47 mm. and 72 by 47 mm. These are smaller than the dimensions given by D'Orbigny (83 by 54 mm.). The photograph (pl. 53, fig. 3) shows two young birds with whitish down and blackish bills fairly well concealed against the rock beneath a barely overhanging ledge.

THE CHIROTE.

The small "chirote," *Cinclodes taczanowskii* Berlepsch and Stolzmann, is of particular interest as the only land bird, beside the condor and the buzzard, observed on any of the islands. They were seen only on islands of the south—the Chinchas—and the Isla Vieja at Independencia Bay.

Our camp on the north island of the Chincha group was located on a small crescent-shaped bit of beach between the water and the cliffs, where the chirotes were regularly seen flying back and forth from the cliff to the beach. Their nests were not observed, but the time was early winter of the southern hemisphere—June, 1907. In the gonads of a specimen taken the eggs were distinguishable only with a lens. The stomach contained sand and bits of shells of Gastropods and Lamellibranchs.

The lively *Cinclodes* recalls both the Wheatear and Dipper, as it runs with upturned tail from stone to stone, takes short low flights, or hunts for crustaceans, mollusks, and insects in the water, equally happy on the streams of the Andes or the desolate lake sides of Patagonia. The note is a sharp trill, while three eggs are laid on a bed of grass and fur in holes.[1]

It is believed that this is the first record of this bird from the Peruvian Islands. Cinclodes belongs to the family Furnariidae peculiar to the neotropical region.

THE SEA LIONS IN RELATION TO THE BIRDS.

Two kinds of "lobos" are distinguished on the Peruvian coast—"lobos ordinarios" and "lobos finos," or "lobos de dos pelos" (*ordinary "lobos"* and *fine "lobos"* or *"lobos" with two coats*). This

[1] A. H. Evans, in the Cambridge Natural History.

distinction corresponds to sea lions and fur seals. I did not observe the fur seal, but from the uniformity of local accounts I would assume that it occurs in small numbers as far north as the peninsula of Paracas.

The sea lion, *Otaria jubata*, occurs fairly abundantly along the entire coast. There is scarcely an island of any size without its "loberia" or rookery of sea lions. Naturally, this animal has some relation to the birds. Many persons have charged them with being very destructive of the guano birds. Some years ago the capture of lobos in Peru was permitted and it was found that the value of the hides and oil was sufficient to make the industry profitable. Subsequently this fishery was stopped by governmental prohibition, chiefly because of the extensive use of dynamite, but partly because it was suggested by some persons that the lobos rendered an important and necessary service to the birds in herding the fishes, driving them to the surface, or demoralizing them, and consequently making it easier for the birds to obtain their food. These questions were of particular interest and it was consequently kept in view to note such observations as might bear on them.

To the sea lions has also been ascribed some importance as producers of guano; in fact, the literature of the subject almost invariably attributes Peruvian guano to the "birds and sea lions." Some definite observations were made on this point, and it may not be inappropriate to refer to them briefly and before proceeding to the proper subject of the section, in order to establish more precisely the significance of the birds in relation to the valuable deposits of guano.

THE SEA LION AS A PRODUCER OF GUANO.

It is well known that there have been deposits regarded as lobo guano, deposits which may have been entirely guano of lobos, or a mixture of the guanos of lobos and of birds. That the lobos now produce a very insignificant amount of available guano seems to be the unanimous opinion of those most practically concerned with the guano industry. I have observed a good many hauling grounds of sea lions between Paita and Independencia, but have usually found that the rocks were clean. The resting grounds were, as a rule, on the rocks close to the water, and, as the sea lions floundered and slid over the rocks going into and out of the water, they swept away with them not only their own, but also such guano of birds as may have been in the way. The rocks are thus left smooth and slippery.

Some exceptions must be made. A small island was visited in 1907 off the Punta Lobería, just above Cerro Azul, where there had been a recent deposit of "lobo guano." According to the best information that could be obtained, this island was cleaned of guano

10 years before and was not worked afterwards until the season of 1906. During two years there were removed in all something over 3,000 tons. If this information is correct, this guano was deposited during a period of 10 years, and at the average rate of 300 tons a year. This is on the supposition that the island was really cleaned 10 years before, though it is probable that it was not cleaned then with the same thoroughness with which islands are swept now.

The guano was different in appearance and odor from that of birds, an abundance of hair being especially noticeable. There was an enormous quantity of skeletons and skins of lobos, many of which perhaps had been left on the island when it was last cleaned of guano. Although, except for the hairs and bones, it was largely pure manure (with only 8 per cent of sand), there was scarcely any odor of ammonia. The color was brown to black and somewhat greasy.

Analyses of two samples of guano taken from different places on this island, as made by Mr. H. H. Bunting, chemist of the Peruvian Corporation, are given in the first two columns of the following table:

	(1) "Sea-lion guano," Cerro Azul.	(2) "Sea-lion guano," Cerro Azul.	(3) "Sea-lion guano," Lobos de Afuera.	(4) "Sea-lion guano," Pure sea-lion faeces.
Moisture	29.40	23.40	8.32	43.96
Sand	8.22	8.05	1.15	.40
(*a*) Organic matter	17.74	18.86	48.43	18.94
(*b*) Phosphoric acid	16.80	19.88	16.89	16.34
Alkali, salts, etc	27.84	29.81	25.21	20.36
	100.00	100.00	100.00	100.00
(*a*) Containing nitrogen	2.86	3.21	7.90	2.33
Equal to ammonia	3.47	3.89	9.59	2.83
(*b*) Equal to tricalcic phosphate	36.67	43.41	36.87	35.67

The presence of some feathers suggested a degree of participation by birds in forming the deposit, but the low nitrogen value proves that the part of birds was inconsiderable.

Another small island, in the Lobos de Afuera group, contained a deposit of mixed lobo and bird guano, the high proportion of nitrogen indicating a substantial proportion of bird guano. The analysis is given in the third column of the table of analyses.

The latter deposit had been formed in a more humid climate (Lobos Island) than the other (Cerro Azul), so that the guano would naturally have suffered more deterioration; yet the nitrogen content was higher and there was other reason to suspect that birds had contributed to the formation of the deposit. In order to ascertain just what was the nature of the fresh lobo guano unmixed with that of bird, several portions of fresh faeces were taken and mixed to form one sample, which was dried, bottled, and analyzed. The result is shown in the fourth column. The nitrogen figure is even lower than the samples taken from the beds at Cerro Azul, but after allowance

is made for the varying proportions of moisture in the total, it will be found that the proportion of nitrogen to solid matter is almost exactly the same in the pure guano as in the two Cerro Azul samples.

From the most elementary principles of mammalian physiology it is, of course, to be inferred that the nitrates would be absent from the guano on account of being excreted with the urine and in a form subject to loss both by evaporation and seepage. From all observations it is safe to say that the sea lions should not be credited with any significant part in the formation of the guano deposits, both on account of the small amount deposited by them in secure places and because of the low nitrogen value of the guano.

THE SEA LION AS ENEMY AND COMPETITOR OF THE BIRDS.

The suggestion that the sea lions, as great consumers of fish, have caused a serious diminution in the food supply, and consequently in the abundance of birds, may be briefly dismissed. Sea lions are, of course, competitors of the birds in the search for food, but the sea lions and birds have existed together for untold ages, and there is entirely wanting any evidence of suffering on the part of the birds for want of food. On the contrary, I was invariably impressed with the comparatively brief portion of the day occupied by the cormorants and pelicans in the search of food, and the correspondingly considerable proportion of the time which they spend upon the islands. There is every reason to believe that these birds are not nearly up to the maximum number which might exist upon the normal food supply, and the deficiency is without any question attributable to the molestation of the rookeries during the past 60 years.

That the sea lions will destroy birds at times is indisputable. Many persons with long experience on the islands mentioned having seen the sea lions eat the birds or tear them open for the fish contained within. Many of these observations are perhaps made under abnormal circumstances when helpless birds are forced into the water. However, I had the rare opportunity to witness the killing of a pelican by a sea lion, and the incident is worthy of description. It should be mentioned that this was near an abandoned island, so that there was no known unusual circumstance to demoralize the bird.

When first seen the lobo had taken the bird apparently by the legs. He dragged it about a little and then by an arched dive carried his captive completely out of view under the water. After a few seconds they were up again. This action was repeated several times, the lobo evidently endeavoring to get a good hold with his jaws on the belly of the bird, protected by its very thick covering of feathers. At first the pelican made so little struggle that I should have thought it dead, but that the neck was held quite erect. It seemed thoroughly demoralized, but, after the third dive, began to fight the lobo with

its big bill. The defense was quite useless. It was carried below the surface, and when it appeared again its helpless condition and the blood in the water showed that the fight was finished. The lobo was tearing off the meat from the belly and the water about was red. He continued tearing his prey until our boat could arrive and take the mutilated body. This was subsequently photographed. The skin and feathers of the whole lower part of the body, with the meat, some of the bone, and the entrails, had been torn away. As the lobo was still tearing at the alcatraz when it was taken, it is evident that the meat of the bird, and not simply the fish within, was the object of the attack. On another occasion I found floating in the water a bird mutilated in similar fashion. It was evident, however, that these cases were so rare that, so far as the birds were concerned, no serious destructive effect could be charged to the sea lions.

Reference has been made previously to the evident fear of large animals, such as porpoises and sharks, manifested by a tamed pelican.

THE ALLEGED COMMENSAL RELATION OF SEA LIONS AND BIRDS.

It is undoubtedly an advantage to the birds that larger animals demoralize the schools of small fish and keep them at the surface. Yet I was not able to see the same close relation in this way, between useful birds and sea lions, as between birds and bonitoes. Frequently, there have been opportunities to observe a school of anchobetas pursued by bonitoes below and birds above. As one watches such as assembly of fishes and birds appear from the distance on the one side, pass and disappear again on the other, the thousands of small fish breaking the surface as the bonitoes leap among them and the cloud of birds plunging and diving, one is left with little doubt as to the benefit that the guano-producing birds may derive from the bonitoes. In regard to sea lions, porpoises, and sharks, this relation is not so clear. The small birds which pick their food from the surface without necessarily going into the water, such as the terns and sea gulls, may frequently be seen hovering over and following the sea lions for advantage in capturing small fish. There is no doubt as to the benefit they derive, although such fowl are not valued from the economic side. The chief birds, the "guanay" and the pelican, as well as the gannet, take their fish by going into the water, and it is probable that fear of the sea lions and other large animals would deter these forms from dropping into the sea close about such animals. For several minutes I have watched pelicans and gannets circle over a school of anchobetas without a plunge, until I supposed that the birds could not be hungry, for the fish were breaking the surface in a dozen places and were easy of access; then suddenly they began to make their headlong plunges from the air. It is difficult to apply any other explanation for the delay than that a preliminary recon-

noissance is necessary in order to ascertain what other animals are after the fishes. With many opportunities for observation, I observed the large birds feed from schools of fish that I knew to be pursued by lobos only where the school was an immense one, and, therefore, where there could be little to fear from the sea lion.

There is yet another point of view from which some light may be be gained. If the lobos are of especial value to the birds we might expect to find some direct relation between birds and lobos in their distribution. Are the birds found in greatest abundance where the lobos are most numerous?

At the islands of Lobos de Tierra there were observed considerable numbers of birds, but not a large number of lobos, although one outlying island, occupied around its base by sea lions, was crowned with a rookery of guanays. At Lobos de Afuera the birds were still more numerous, especially pelicans, but sea lions were comparatively few. Macabi Island was almost without birds, but was surrounded by populous loberias. At Guañape there were a great many gannets, but, at the time of my visit, few other birds. There were considerable numbers of sea lions. In the Bay of Chimbote there were not many birds, but an abundance of lobos. In the Chincha and Ballestas Islands, the only island which had practically no nesting ground was the middle island of the Chinchas, and this was the island about which were found the greatest number of lobos. San Gallan showed few birds, but some large loberias. In the region of the Bahía de Independencia, with its islands of Vieja and Santa Rosa, sea lions are very abundant, while birds are practically absent. Only the small terrecle was abundant at Santa Rosa, and this is the kind of bird that may derive much help from the lobos, because they barely strike the surface of the water as they take their fish, but they produced little guano.

In almost every case the disappearance of the birds, or their decrease in numbers, is largely due to the way they have been treated by man, although the sea lion may have formed a part of the unfavorable condition. For example, at such a place as the Santa Rosa Islands, it is probable that the sea lions did not accomplish great harm to the birds until the working of the islands began. Immature birds that could fly from the land, but could not rise from the water, into which they had been driven by man, would fall an easy prey to the sea lions. It is very natural that the birds would abandon those points where they were pursued both on land and on the water, sooner than those where their enemies were only on the land.

The conclusions arrived at from all observations were: (1) That the sea lion as a producer of guano was not of sufficient value to require its protection; (2) that, as regards the relation between the sea lions and the birds, the evidence did not indicate that the sea

lions were either of much benefit or of very significant injury; (3) that when the good was balanced against the harm, the difference could not be sufficiently great either way to demand the destruction of the sea lions, on the one hand, or the absolute protection of them, on the other.

The sea lions are, of course, destructive to fishing apparatus and even to fish when in nets or on the hooks. It was recommended to the Government that a limited catch be permitted, the use of dynamite to be prohibited, and the number to be taken in any locality to be restricted, with a view to the preservation of the species and promotion of the industry.

BIRDS OF THE CHINCHA ISLANDS IN THE PAST AND THE PRESENT.

On becoming acquainted with the guano islands on the coast of Peru it seemed to me rather surprising that it should have been supposed and so frequently stated in works of reference that the chief guano-producing bird was the *Sula variegata*, or "piquero." Tschudi, in fact, selected this bird for experiment and found that it produced 3½ to 5 ounces of guano a day. It was assumed at first that Tschudi had been misled by the fact that these birds are exceedingly abundant and by their conspicuousness in the harbors, where their precipitous and graceful plunges must attract the attention of any observer. But how could he have overlooked those long black streaming clouds of "guanays" (*Phalacrocorax bougainvillei*) which lie low over the water for miles?

Stating briefly the conditions as they were in 1906 to 1908, the "guanay" is by far the most important producer of guano, while the pelican is second, and the other birds fall far behind. In June there were 15 acres of guanays on the south island of the Chinchas (latitude 14°), and two months later the extent of the flock was probably well over 20 acres. I saw no other flock, neither of cormorants nor of any other species, to compare to this one, and there were, besides, many smaller aggregations of guanays on various islands. North of Independencia, at least, this was the chief guano-producing bird, except in the north, at the Lobos Islands, where the pelican took first rank. Even at the Lobos de Tierra there was a large flock of guanays. The scarlet-foot cormorant, or so-called "pato de mar" (sea duck), *Phalacrocorax gaimardi*, is one of the most common birds along the coast south at least of Guañape, but, from its habit of nesting on the cliffs and in the caverns, is of no value as a producer. And the same may be said of the less abundant black cormorant, or cuervo de mar, *P. vigua*. The bird next in rank to the pelican is the piquero, *Sula variegata*. The small diving petrel, *Pelecanoides garnoti*, deserves consideration from its abundance in certain localities and from the supposed value of its guano. The penguin, *Sphe-*

niscus humboldtii Meyen, found from Lobos de Afuera southward, is not now sufficiently abundant to count, economically speaking. Other birds, such as the gulls, and terns, are very numerous, but for various reasons they are of quite secondary economic significance.

It will be of interest now to compare the accounts of previous observors. Unfortunately few of the naturalists who have made collections and observations on the Peruvian coast actually made visits to the guano islands and left records of their observations.[1] If we go back to Humboldt, we find his statement (as quoted by Raimondi and others) that the Chincha Islands were occupied by a multitude of birds, especially "ardeas" and "fenicopteros" (herons and flamingoes), a statement which it would indeed be difficult to credit. Since he also states that these birds have not in the course of three centuries, been able to produce more than a thickness of 4 or 5 lines of guano (whereas in fact many times this thickness is deposited in one year), we must believe, either that Humboldt wrote from information received at second-hand, or else, as Raimondi suggests, that the presence of the birds mentioned was a chance observation. In any event we must neglect this account.

[1] The earliest published reference to the guano birds is found in Garcillasso de la Vega, who made no mention of the varieties of birds contributing to the guano deposits. His record is however, of great interest and importance, not only for its historical value, but because of its definite recognition of the significance of contemporary birds as agents in guano production. This native historian possessed, of course, a more accurate knowledge of conditions and a more intimate experience with things concerning Peru than Humboldt, who, though he must be credited with the principal part in directing the attention of the world to the possibilities of the guano deposits, yet seems to have been responsible not only for manifestly incorrect statements regarding the birds, but for establishing for the time being, the erroneous and unfortunate impression that the deposits were of a merely fossil nature and unreplenishable. Had Humboldt given correct information it might earlier have been recognized that it was commercially useful to protect the birds as was done in the time before the conquest. Garcillasso de la Vega's record is of sufficient interest and relevance to be given, as quoted and translated from Raimondi:

"By the seacoast from below Arequipa as far as Tarapaca, which is above 200 leagues, they use no other manure but such as is derived from the marine birds, which live along the entire coast of Peru, large and small, and which go in flocks of a size that is incredible if they are not seen. They breed upon the uninhabited islands which occur along that coast: and so much is the excrement which they leave upon them that this likewise is incredible. The mounds of manure appear from a distance as snowy mountains. In the time of the Inca kings such vigilance in guarding the birds was maintained that, at the time of breeding it was forbidden to anyone to enter on those islands, under penalty of death, in order that they might not disturb nor drive them from their nests. Neither was it permitted to kill them at any time within or without the islands, under like penalty." (Antonio Raimondi: El Peru. Vol. 4, p. 489. See also: The Royal Commentaries of Peru in two parts: written originally in Spanish by the Inca Garcilasso de la Vega and rendered into English by Sir Paul Rycaut, Kt., London, 1688. Part 1, Book 5, Chapter 3, p. 135).

It is remarkable that the rulers of Peru in the days before the conquest should not only have realized that the birds must receive protection, but that they should have seen the necessity of adopting for this purpose, such an economic system in the exploitation of deposits as has in recent years been recommended to the Government of Peru. (See the writer's article in Science, cited on p. 449 above.) For the Inca goes on to say:

"Every island was by order of the Inca assigned to such and such provinces, and if the island were very large, then two or three of them divided the soilage, the which they laid up in separate heaps, that so one province might not encroach on the proportion allotted to the other: and when they came to make their division to particular persons and neighbors, they then weighed and shared out to every man the quantity he was to receive; and it was felony for any man to take more than what belonged to him, or to rob or steal it from the ground of his neighbor, for in regard that every man had as much as was necessary for his own lands, the taking a greater quantity than what belonged to him, was judged a crime, and a high offence; for that this sort of birds dung was esteemed precious, being the best improvement and manure for land in the world. Howsoever, in other parts of that coast, and in the low countries of Atica, Atiquipa, Villacori, Malla, and Chillca, and other Valleys, they dung their grounds with the heads of a small fish, like our pilchards, and with no other soilage." (Royal Commentaries, p. 136.)

Tschudi, however, seems to have visited the Chincha Islands (and others) and he mentions several species as important.

> Guano is formed of the excrements of different birds, as mews, divers, sheerbeaks, etc.; but the species which I can name with more precision are the following: *Larus modestus* Tschudi [gull]; *Rhincops nigra* Linnaeus [skimmer]; *Plotus anhinga* Linnaeus [snake-bird]; *Pelecanus thayus* Molina [pelican]; *Phalacrocorax gaimardi* [patillo] and *albigula* [guanay] Tschudi; (*Pelecanus gaimardi* Lesson, *Carbo albigula* Brandt), chiefly the *Sula variegata* (Tschudi), [gannet].[1]

I have inserted the common names. As previously indicated, he placed special emphasis upon the gannet.

When a gentleman of many years experience on the islands, speaking to me of the great diminution in number of birds, especially pelicans, during the period of his acquaintance with the islands, added that the "guanays," however, were by no means so abundant in the earlier years, it seemed that the discrepancy between old accounts and actually existing conditions, as regards this species, might be due to local or regional movements of the birds. This inference is borne out by Tschudi's explicit statement in another work [2] that he encountered the guanay more often on the south coast in the region of Arica and Islay (17° and 18° S.). Paz Soldan,[3] writing in 1862 (and apparently following Raimondi) does not single out the cormorant for special mention in his account of the Chincha Islands (p. 44); but in treating of the guano of the southern province of Tarapaca he refers particularly to "the birds that produce it, which they call in Quichua *Huanay*" (p. 521, translated).

Raimondi's account, however, seems to offer a better basis for comparison.[4] He spent 40 days on the Chincha Islands (evidently in 1855) and his notes should be correct for the time. He lists two cormorants (*bougainvillei* and *gaimardi*) with this remark, which is not true now as applied to the former species (translated):

> It appears that the Carbos do not contribute much to the formation of guano, since they live almost always on the more rugged places and in the clefts of the rocks, so that the guano they produce generally falls into the water.[5]

We must believe that the guanays were not occupying the Chincha Islands "in mass" in the times of Tschudi's or Raimondi's visits

[1] J. J. von Tschudi. Travels in Peru during the years 1838–1842. Translation by Thomasina Ross, New York, 1852, p. 168. [The guano industry had no importance in Tschudi's day and it does not appear that Tschudi was correctly informed as to the general conditions, though his observations are doubtless correct for certain points visited.]

[2] Tschudi, J. J. von. Untersuchungen über die Fauna Peruana. 2 vols. St. Gallen, 1844–46. Section "Ornithologie" in second volume, p. 314.

[3] Paz Soldan, D. D. Mateo. Geographia del Peru, obra postuma del D. D. Mateo Paz Soldan, corregida y aumentada por su hermano, Mariano Felipe Paz Soldan. 2 volumes, Paris, 1862, 1863.

[4] Raimondi, A. Mémoire sur le huano des isles de Chincha et les oiseaux qui le produisent. Comp. rend, Acad. Sci., vol. 42. Paris, 1856.

Raimondi, Antonio. "Apuntos sobre el huano y sobre las aves que lo producen." The paper is undated, as published posthumously in the fourth volume (pp. 487–496) of Raimondi's "El Peru," Lima, 1902 (cited on p. 469 above). It appears to have been originally published in 1874, in El Siglo, ano 1, Nos. 1 and 2, and to be based upon the article in the Compte Rendus, previously cited.

[5] Raimondi, A. 1902 [1874] El Peru, p. 494.

(1842 and 1855). It is possible but hardly probable that they were on other islands of the immediate region at that time. It is to be remarked that the south islands, which seems best suited to the guanay, was unoccupied at that time by guano workers, and was, according to his statement, the chief home of the penguin (which is more easily disturbed by intruders than the guanays), and that it was besides abundantly populated with diving petrels.

Raimondi's remarks regarding the relative abundance of the several species of birds (except as regards the guanay) may be approximately true to-day. Plotus and Rhyncops, he says, are very rare. Of *resident* birds ("sedentarias") those which most abounded in the order, in which he named them, were the pelican, the gannet, the gull (*L. modestus*) the penguin, and the diving petrel. It is evident, then, that these islands were simply preempted by other species, then vastly more abundant than now; accordingly, the guanays found more living room at other places, especially, by Tschudi's account, in regions much further south. In later years the species formerly dominant have, in consequence of the more extensive industrial activities on the islands, either diminished in numbers or been driven to other nesting grounds, making way for the guanay—a species which is less sensitive to disturbance.

In regard to the guanay, then, it must be concluded either that it has greatly increased in numbers during the past half a century, or else that it has appeared in regions where it was not formerly a regular habitant. The latter is by far the more probable conclusion, for its ancient common name would indicate that it was recognized as the paramount guano bird of prehistoric times, as it is of the present.

The Sulas, Raimondi stated expressly,[1] produce more guano than the pelicans or the cormorants, because, besides inhabiting the rugged places they cover at times a part of the island ("cubren a veces la parte de las islas"). This statement with its qualifying phrase, "at times," scarcely confirms Tschudi, but in the earlier paper[2] he says "they keep themselves in the interior of the island." As these birds in their present abundance find adequate nesting ground upon the cliffs and comparatively abrupt slopes, they now rarely overflow onto the more level ground. This applies not only to the Chinchas, but to the entire coast as observed. We are perhaps justified in assuming that the Sulas have diminished considerably in numbers since the period of Tschudi's or that of Raimondi's observations.

The penguin, *Spheniscus*, in Raimondi's time, had quite abandoned the north island, and was rarely found on the middle (these two were being worked), but were in "great abundance" on the south island. These helpless penguins are now in vastly reduced numbers, for, while they are frequently in evidence about the islands of the Chincha

[1] Raimondi, A. El Peru, 1902 (1874). [2] Raimondi, A. Le huano des isles de Chincha, 1856.

region and in the Bay of Independencia, 60 is the largest number I have seen in one group.

Another striking observation of Raimondi's is in regard to the diving petrel or "potoyunco" (*Pelecanoides garnoti*), and is expressed as follows (translated):

> Finally, the *Puffinurias*, in my opinion are the birds which produce the greater quantity of guano; as much for the quantity which each deposits, as for the incalculable number which inhabit these islands. It appears also that these birds are continually diminishing in the north island, being found only toward the southeast part of the island; while on the middle and southern islands they are found in all parts. Like the preceding (*Spheniscus humboldtii*) they live under the guano at a depth of 1 or 2 feet, having thus with their galleries mined the whole southern part of the north island; so that one may not make a step in this part without sinking to the knees.[1]

It is surprising that Raimondi should ascribe to the penguin, as well as to the diving petrel, the habit of burrowing under the guano.

He goes on then to describe how the Chinese peons destroy great quantities of these birds, taking them from their subterranean nests and preserving the meat by drying in the sun. This unfortunate night work still continues, being followed not only by the laborers on the island, but by the fishermen of San Andres near Pisco, who make a practice of salting the birds to eat or to sell subsequently at home.

The potoyuncos are now found on all islands of this region, but there are not enough left on the islands of the Chincha and Ballestas groups for anyone to attach especial importance to the amount of their guano production. Their chosen home, at the time of my observations, was the lofty San Gallan, whose long hillsides are in many places undermined by the crowded burrows of these little birds, from the hard saline crust at the base of its sweeping slopes up to the grassy summits of the peaks that are lost to view in the clouds. Even here, much as one may be impressed by the comparative abundance of these interesting birds, or by the persistence with which they will ascend into the very clouds in the vain endeavor to find a safe retreat for their tunnels, one can not ascribe to them a relatively great economic value. The diving petrels, too, we must conclude, have been greatly reduced in numbers.

Finally, although there is little in the statements of the writers mentioned to show that the pelican was ever much more abundant than now, I had too much testimony from various sources, and too much independent evidence, to doubt for a moment, not only that this bird was much reduced in numbers, but that it was tending toward elimination as a commercially significant guano producer.

As bearing upon the changes of aspect in the bird life of the island reference should be made to the phenomenal disappearance of some

[1] Raimondi, A. El Peru, 1902 (1874), p. 495.

of the principal species of birds in 1911, as recorded by Forbes [1] and tentatively attributed to a possible seismic disturbance of unusual severity. From his further remarks it may be inferred that the birds returned in full numbers before his observations on the coast were concluded.

I would not conclude these remarks without adding the hopeful note that under the vigorous protection which Peru must sooner or later extend to its sea birds in defense of its guano and agricultural industries, an opportunity will be given to all the useful species to regain as best they can, the condition of abundance determined by the conditions of their natural environment.

[1] See citation of Forbes papers on p. 487 and p. 490, above.

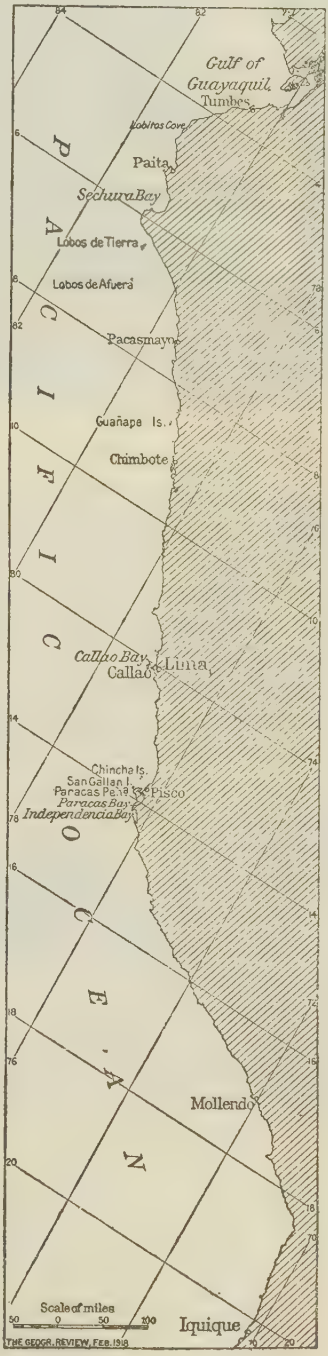
APPENDIX.

LATITUDES OF PLACES MENTIONED IN THE TEXT.

Among the points visited by the writer those mentioned in this paper, with their approximate latitudes indicated, are named in the following list, and the locations of the principal places are shown on the accompanying sketch map of the coast of Peru:[1]

3°	30′ S.	Tumbes.
5		Paita.
6	30	Lobos de Tierra Island, and islets.
6	56	Eten.
6	57	Lobos de Afuera Islands, East, and West, and islets.
7	24	Pacasmayo.
7	50	Macabi Island.
8	36	Guañape Islands, North and South.
9	08	Chimbote.
11	48	Pescadores Island.
12		Callao.
12		San Lorenzo Island.
12	20	Pachacamac Island.
12	30	Chilca.
12°	48′ S.	Asia Island.
13		Punta Loberia and islet.
13		Cerro Azul.
13	40	Pisco.
13	39	Chincha Islands, North, Middle, and South, with islets.
13	40	Blanca Island.
13	44	Ballestas Islands, North, Middle, and South, with islets.
13	50	San Gallan Island.
13	50	Paracas Peninsula.
13	59	Zarate Island.
14	16	Vieja Island, Bay of Independencia.
14	16	Santa Rosas Islands, Bay of Independencia.
17		Mollendo.

[1] The map is reproduced by courtesy of the Geographical Review published by the American Geographic Society, New York City.



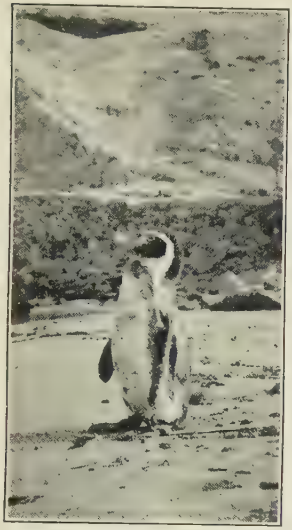


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FIG. 1. PENGUIN, SPHENISCUS HUMBOLDTI MEYEN, FROM BALLESTAS ISLANDS, JUNE, 1907

FOR DESCRIPTION SEE PAGE 455

FIG. 2. ALBATROSS, DIOMEDIA IRRORATA SALVIN, TAKEN NEAR LOBOS DE TIERRA ISLAND, JANUARY, 1908

FOR DESCRIPTION SEE PAGE 461

FIG. 3. NESTLINGS OF TURKEY VULTURE, CATHARTES AURA, LOBOS DE TIERRA ISLAND, DECEMBER 14, 1907

FOR DESCRIPTION SEE PAGE 499

NESTING PLACE OF INCA TERN, LAROSTERNA INCA (LESSON), ON ASIA ISLAND, AUGUST 25, 1908

FOR DESCRIPTION SEE PAGE 461

DOMINICAN GULLS, LARUS DOMINICANUS LICHTENSTEIN, LOBOS DE TIERRA ISLAND, APRIL 2, 1907

FOR DESCRIPTION SEE PAGE 458

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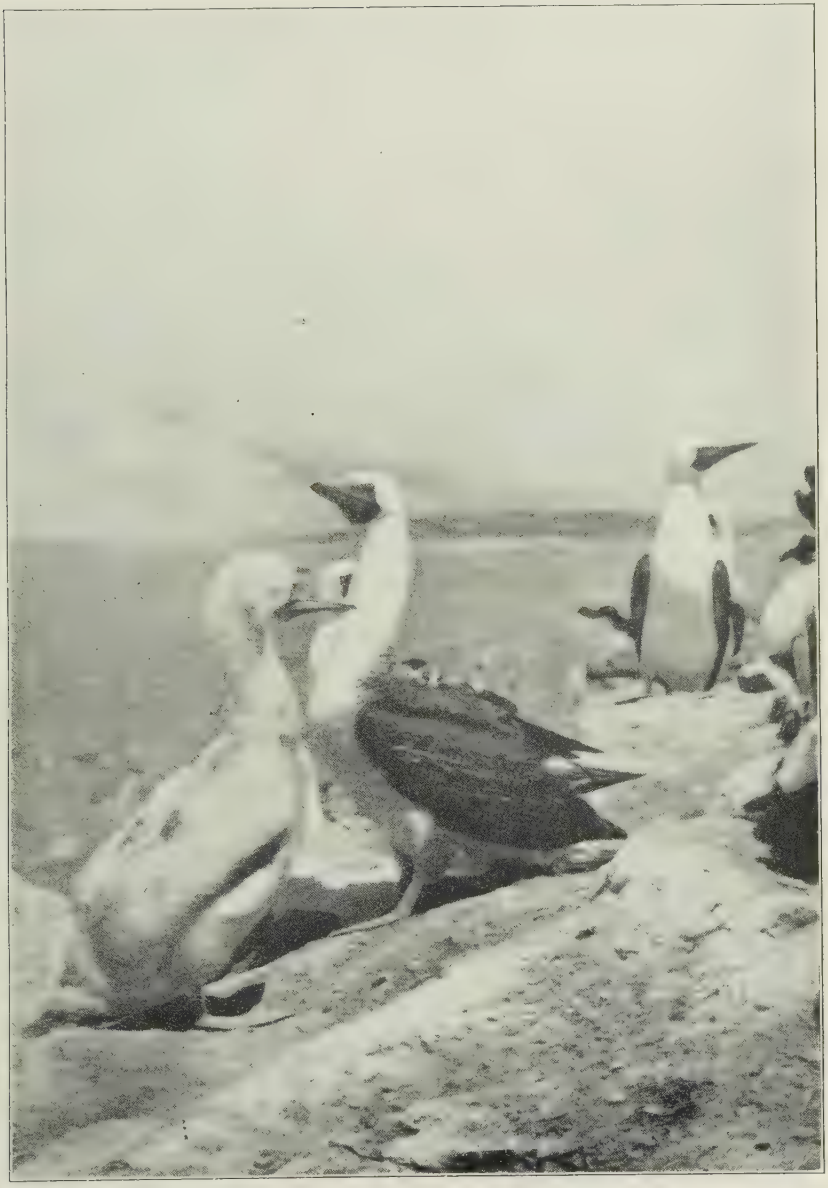
2

FIG. 1. NESTING PLACE OF DOMINICAN GULL, LARUS DOMINICANUS LICHTENSTEIN, LOBOS DE TIERRA ISLAND, JANUARY, 1908. NEST OF SULA NEBOUXI NEAR FOREGROUND

FOR DESCRIPTION SEE PAGE 469

FIG. 2. YOUNG PIQUEROS, SULA VARIEGATA (TSCHUDI), LOBOS DE AFUERA ISLAND, MARCH 25, 1907

FOR DESCRIPTION SEE PAGE 467



ADULT AND NESTLING PIQUEROS, SULA VARIEGATA (TSCHUDI), LOBOS DE AFUERA, MARCH 22, 1907

FOR DESCRIPTION SEE PAGE 466

NESTING PLACE OF PIQUEROS, SULA VARIEGATA (TSCHUDI), GUAÑAPE ISLAND, MARCH 5, 1907

FOR DESCRIPTION SEE PAGE 467

NESTING PLACE OF PIQUERO, SULA VARIEGATA (TSCHUDI), CHINCHA ISLANDS, JUNE 12, 1908

FOR DESCRIPTION SEE PAGE 467

1

2

FIG. 1. SHOWING NESTING HABIT OF SULA NEBOUXI AT LOBOS DE TIERRA ISLAND, JANUARY, 1908. ADULT BIRDS

FOR DESCRIPTION SEE PAGE 471

FIG. 2. NESTS OF SULA NEBOUXI MILNE-EDWARDS, LOBOS DE TIERRA ISLAND, APRIL 2, 1907

Note different stages of development shown by the two nestlings at nest in foreground

FOR DESCRIPTION SEE PAGE 472

GUANAYS, PHALACROCORAX BOUGAINVILLEI (LESSON), AT NESTING GROUND ON CHINCHA SOUTH ISLAND JUNE 15, 1907.
COMPARE PLATE 62

FOR DESCRIPTION SEE PAGE 474

GUANAYS, CHINCHA SOUTH ISLAND, JULY 12, 1907

The two views, plates 61 and 62, each represent very small portions of a nesting ground covering 15 acres

FOR DESCRIPTION SEE PAGE 474

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FIG. 1. YOUNG PELICANS AT NESTING GROUND ON ISLET OFF NORTH END OF EAST ISLAND OF LOBOS DE AFUERA GROUP, MARCH 28, 1907

FOR DESCRIPTION SEE PAGE 490

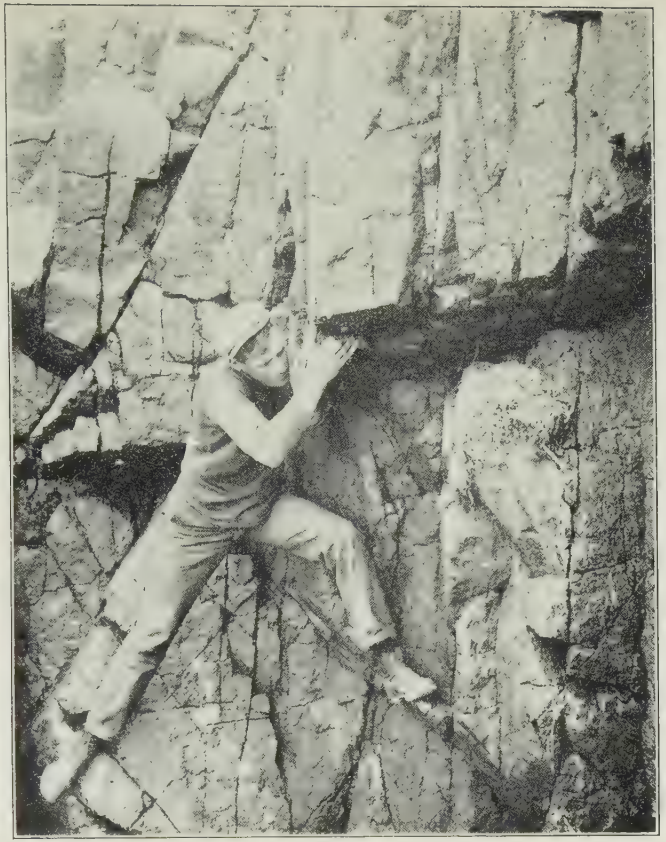
FIG. 2. NESTS OF GUANAY, PHALACROCORAX BOUGAINVILLEI (LESSON), SOUTH ISLAND OF CHINCHAS. JULY 12, 1908

FOR DESCRIPTION SEE PAGE 476

NESTING PLACE OF CUERVO DE MAR, PHALACROCORAX VIGUA (VIELLOT), LOBOS DE TIERRA ISLAND, DECEMBER 14, 1907

Cuervos are seen on rocks and on the water in foreground. Piqueros and pelicans appear in background

FOR DESCRIPTION SEE PAGE 479



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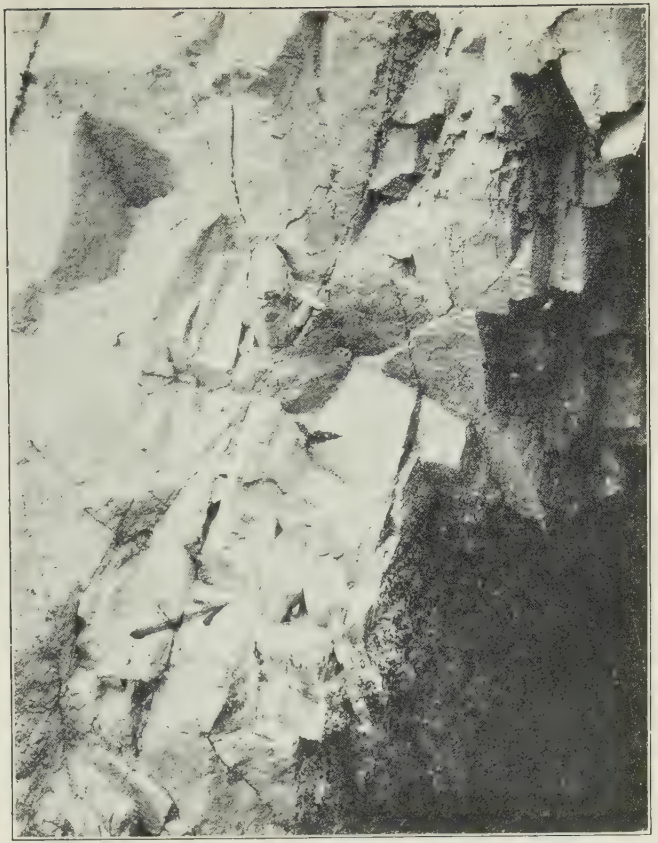

2

FIGS. 1 AND 2. NESTS OF PATILLO, PHALACROCORAX GAIMARDI (GARNOT), NORTH ISLAND OF CHINCHAS, JUNE 7, 1907

The arrow in figure 2 points toward a pair of nestling birds

FOR DESCRIPTION SEE PAGE 480

PORTION OF NESTING GROUND OF PELICANS, LOBOS DE AFUERA, WEST ISLAND, DECEMBER 3, 1907

FOR DESCRIPTION SEE PAGE 486

PORTION OF NESTING GROUND OF PELICANS, LOBOS DE AFUERA, WEST ISLAND, DECEMBER 3, 1907

FOR DESCRIPTION SEE PAGE 488

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FIG. 1. ADULT PELICAN IN PHASE OF LIGHT GRAY PLUMAGE. CHINCHA ISLANDS, JUNE 18, 1907

FOR DESCRIPTION SEE PAGE 486

FIG. 2. ADULT PELICAN AND NESTLINGS IN VARIOUS STAGES. LOBOS DE AFUERA ISLANDS, MARCH 28, 1907

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FIGS. 1 AND 2. YOUNG PELICAN AT THE STAGE WHEN BEGINNING TO FLY, LOBOS DE AFUERA, APRIL 6, 1907

FOR DESCRIPTION SEE PAGE 490

REPORT ON A SMALL COLLECTION OF INDIAN PARASITIC HYMENOPTERA.

By A. B. Gahan.

Of the Bureau of Entomology, United States Department of Agriculture.

The Hymenoptera listed and described in the following pages and belonging to the superfamilies Chalcidoidea and Serphidoidea are part of a lot of material received by the Bureau of Entomology from Ramakrishna Ayyar, acting government entomologist, Madras Agricultural College, Coimbatore, Southern India. Most of it is reared material, although in many instances the name of the host insect is unknown. A large part is said to have been reared from galls on various plants and some of the Eurytomids may prove to be phytophagous. The new species of *Bruchophagus* will without much doubt prove to be a destroyer of the seeds contained in the pods from which it was reared.

The collection as a whole forms an interesting addition to the as yet largely unknown Indian fauna. In addition to the forms described here this lot of material contained a number of species of Eulophidae and Elasmidae which will be treated separately by Mr. J. C. Crawford, of the Bureau of Entomology, who has cooperated with the writer in determination of the entire lot.

Superfamily CHALCIDOIDEA.

Family EURYTOMIDAE.

BRUCHOPHAGUS MELLIPES, new species.

Agrees nicely with the generic characterization by Ashmead. Readily distinguished by the reddish testaceous legs from all described species at present placed in the genus.

Female.—Length, 2.4 mm. Head strongly umbilicately punctate; antennae short; first funicle joint a little longer than broad, about equal to the pedicel in length but distinctly thicker; following funicle joints subquadrate or slightly transverse; club not quite as long as the three preceding funicle joints, 3-jointed, the joints subequal in length; clypeus and a slight median longitudinal ridge below the antennae shining, impunctate; pronotum, mesoscutum, and scutel-

lum umbilicately punctate like the head; propodeum strongly declivous, approaching perpendicular, rugoso-punctate laterally, with a broad, very slightly concave median area, which is coarsely, irregularly, longitudinally rugose, and bounded anteriorly and laterally by carinae, the two lateral carinae converging posteriorly; marginal vein scarcely as long as the stigmal, somewhat thickened; postmarginal distinctly longer than either the marginal or the stigmal, and slender; stigmal knob rather large and squarely truncate at apex; discal ciliation delicate; abdomen robust, conic ovate, not compressed, the third tergite the largest, approximately twice the length of the second; second and fourth tergites subequal; those beyond the fourth shorter and subequal to each other; apex of ovipositor barely exserted; fourth tergite faintly reticulated medially, otherwise the abdomen is polished. Black, opaque; the antennal scape reddish testaceous, the flagellum brownish testaceous; all legs, except their coxae and the basal half, more or less, of the fore and hind femora, reddish testaceous; coxae black; fore and hind femora brownish or blackish basally; ovipositor sheath pale testaceous; wings hyaline, venation pale testaceous.

Male unknown.

Type-locality.—Coimbatore, South India.

Type.—Cat. No. 22279, U.S.N.M.

Four females received by the Bureau of Entomology from Ramakrishna Ayyar, and labeled as follows: "Galls in Daincha pods. Insectary. 7–IX–1914." Also one female from the same source, labeled: "From Red gram pods. Y. R., collector, 11–I–1916." By "red gram" pods is probably meant the pods of *Vigna sinensis*.

This species, like its congener *B. funebris*, will in all probability be found to be a true seed Chalcid, destroying the seeds of the plant from which it was reared.

EURYTOMA PARASAE, new species.

Female.—Length, 3.8 mm. Head coarsely umbilicately punctate; face medially with a low, nearly smooth, longitudinal ridge on either side of which the punctures are modified to form several short, irregular, striatiform rugae which converge toward the clypeus; cheeks strongly carinate behind; ocelli rather large, the lateral ones about their own diameter from the eye margin; antennal scape short; pedicel scarcely longer than broad; first funicle joint twice or very nearly twice as long as the pedicel and distinctly longer than twice its thickness, following joints of the funicle gradually decreasing in length, the last funicle joint a little less than twice as long as thick; club no thicker than the funicle, very slightly longer than the two preceding funicle joints combined, 3-jointed, the suture between the first and second club joints deep and distinct, that between the

second and third subobsolete; pronotum, mesoscutum, scutellum, and axillae uniformly umbilicately punctate like the head; propodeum moderately long, declivous, with a broad, deep depression medially, rugoso-punctate laterad of the depression, the depressed area bounded laterally by an irregular more or less obscure carina, rugulose within, with some short, poorly defined, transverse crenulae medially; front coxa beneath with a broad, obliquely longitudinal groove or depression for its whole length, the surface within this depression more or less distinctly, finely, transversely striated; mesosternum with a median longitudinal carina but without a tooth-like projection; hind coxae finely reticulate-punctate; abdomen about as long as the thorax, subcompressed, pointed at apex; fourth tergite about equal in length to two and three combined, all tergites dorsally polished impunctate, third and following tergites laterally weakly reticulate-punctate; ovipositor slightly exposed at apex; marginal vein at least one and one-half times the stigmal, postmarginal distinctly longer than the stigmal. Black; antennal flagellum reddish brown; scape, pedicel, mandibles, palpi, and all legs except the anterior and posterior coxae, reddish testaceous; ovipositor sheaths pale testaceous; wings hyaline, the venation pale brownish.

Male unknown.

Type-locality.—Coimbatore, South India.

Type.—Cat. No. 22280, U.S.N.M.

Six female specimens received from Ramakrishna Ayyar, labeled as follows: "Parasite on *Parasa lepida.* Insectary. 2–XI–1914." Also one female labeled: "Parasite on *Thosea* sp. on Neem. Kurnool Dt., Kodumur. Y. R., collector."

The latter specimen has the antennal flagellum entirely blackish, but otherwise does not differ materially from the type.

EURYTOMA DENTICOXA, new species.

Female.—Length, 2 mm. Head coarsely umbilicately punctate, the face without a smooth median ridge, nearly uniformly punctate; cheeks strongly carinate behind; antennal scape somewhat clavate, more slender apically than at base, pedicel subspherical, a little longer than broad; funicle 5-jointed, submoniliform, the first joint slightly the longest, approximately one and one-third times as long as the pedicel, following joints subequal and very slightly longer than thick; club compact, conic ovate, a little longer than the fourth and fifth funicle joints combined, 3-jointed, the sutures not very distinct; pronotum, mesonotum, scutellum, and axillae umbilicately punctate like the head; propodeum rugoso-punctate, rather deeply excavated medially, the excavation not very broad and not bounded laterally by distinct carinae but with a nearly straight carina on each side of the middle within the excavation, these carinae delicate and parallel,

the area between the carinae finely, transversely rugulose-punctate; marginal vein a little longer than the stigmal, which is about equal to the postmarginal; anterior half of the front coxae excavated beneath, the concavity margined by a carina which is angulated posteriorly, forming a distinct tooth-like projection a little behind the middle; hind coxae outwardly reticulate, shining; abdomen polished, a little longer than the thorax, subcompressed, pointed at apex, the fourth tergite a little shorter than 2 and 3 combined, very distinctly finely reticulate on the sides and with a few very obscure reticulations dorsally; apex of ovipositor barely exposed. Black; the antennal scape testaceous, pedicel and flagellum brown; femora brownish black; tibiae mostly fusco-testaceous, the anterior pair mostly testaceous; ovipositor sheaths black; wings hyaline, the venation pale. Male unknown.

Type-locality.—Coimbatore, South India.

Type.—Cat. No. 22281, U.S.N.M.

One specimen labeled as follows: "From Maize seeds. 7–II–1917. Ramakrishna, collector."

EURYTOMA DENTIPECTUS, new species.

Female.—Length, 2 mm. Similar to *denticoxa*, but differing as follows: Middle of the face not so definitely umbilicately punctate as the sides, with two or three irregular coarse transversely directed rugae on either side of the clypeus; propodeum more broadly excavated and more distinctly defined laterally by somewhat irregular carinae, the lateral margins of the excavation curved and converging toward the base of petiole, the excavation with two and sometimes three delicate, parallel, longitudinal carinae, the sculpture between these carinae transversely rugulose, laterad of the carinae more reticulate-punctate; mesosternum with a distinct tooth or process near the middle; front coxae beneath with a transverse carina which is near the apex of coxae and not angulated to form a tooth-like projection; fourth abdominal tergite medially not as long as 2 and 3 combined, about one and one-third times as long as the third, rather deeply emarginate at apex; scape, all trochanters, middle femora, all tibiae, and all tarsi testaceous, the tibiae faintly tinged with brownish; fore and hind femora dark brown except at base and apex.

Male.—Antennal pedicel spherical, hardly half as long as the first funicle joint; scape a little swollen beneath; funicle joints distinctly pediculate and hairy, the thickened portion only slightly longer than broad, except the first, which is about one and one-half times as long as thick; club not more than one and one-half times as long as the last funicle joint; abdominal petiole smooth, and about twice as long as thick; abdomen short, not longer than high, subcompressed; scape pale at base, dark brown beyond; front tibiae.

bases and apices of middle and hind tibiae, apices of all femora more or less, and all tarsi pale testaceous; legs otherwise dark brown or blackish, the middle femora and all of the tibiae less dark than the fore and hind femora. Otherwise as in the female.

Type-locality.—Coimbatore, South India.

Type.—Cat. No. 22282, U.S.N.M.

Three females received from Ramakrishna Ayyar and labeled as follows: "From gall. T. V. R., collector, 30–VI–1913." One male with same data except dated "18–VI–1913." Also four females labeled: "Parasite from gingelly galls. Y. R. collector, 11 to 19–III–1913."

EURYTOMA SETITIBIA, new species.

Easily distinguished from the other Indian species by the setae on hind tibiae and the entirely pale testaceous antennae.

Female.—Length, 2.8 mm. Head, except a narrow median longitudinal line on the face, coarsely umbilicately punctate; cheeks strongly carinate behind; occiput umbilicately punctate behind the vertex, shagreened below; antennal scape narrowed at apex; pedicel about as long as broad, subglobose; funicle submoniliform, the first funicle joint nearly twice as long as the pedicel and about one and one-half times as long as thick; following funicle joints subequal and very slightly longer than thick; club 3-jointed, compact, longer than joints 4 and 5 of the funicle combined, the second suture not very distinct; pronotum, mesoscutum, and scutellum umbilicately punctate like the head; sides of the scutellum and the axillae below shagreened; propodeum rugoso-punctate laterally, with a broad, rather deep, irregularly carinately margined median excavation which is nearly smooth medially but finely shagreened on the sloping sides; front coxae excavated beneath, but without a transverse carina or tooth; mesosternum with a distinct median carina, but without a tooth-like projection; hind tibiae above on the basal half with three strong stiff setae in addition to the usual fine bristles or hairs, the distal seta the longest and approximately as long as the basal joint of tarsi; marginal vein about one and one-half times the stigmal, postmarginal very slightly longer than stigmal; abdomen about as long as head and thorax, subcompressed, the fourth tergite equal to the first, second, and third combined; fifth very short, sometimes completely hidden by the fourth; stylus rather prominent; apex of ovipositor sheaths exposed; all tergites distinctly reticulate-punctate laterally, less distinctly so dorsally. Black; antennae entirely, fore and middle femora, all tibiae, and all tarsi pale reddish testaceous.

Type-locality.—Coimbatore, South India.

Type.—Cat. No. 22283, U.S.N.M.

Type female and two female paratypes labeled: "Parasite from galls on *Cordia myxa*. T. V. S., collector. 24–V–1917."

EURYTOMA HINDUPURENSIS, new species.

Female.—Length, 2.5 mm. Vertex with a few not very distinct umbilicate punctures; frons between the antennal groove and the eye margins longitudinally reticulated; face with fine striae converging toward the clypeus; cheeks carinately margined behind; temples rugulose-punctate; occiput with shallow nonumbilicate punctures; antennal scape constricted at apex; pedicel small, not longer than broad, and not over half as long as the first funicle joint; funicle joints submoniliform, much thicker than the pedicel, the first joint a little longer than thick, following joints about as long as thick; club distinctly 3-jointed, conic ovate, and somewhat longer than joints 4 and 5 of the funicle combined; pronotum, mesoscutum, scutellum, and axillae umbilicately punctate, the sides of scutellum smooth, and lower two-thirds of axillae more or less granularly sculptured; propodeum laterally rugoso-punctate, the medial impression deep, broad, and not bounded by definite carinae, finely reticulate-punctate medially, the sculpture of the sloping sides more or less transversely rugulose; front coxae beneath apparently excavated from base to apex, without a tooth; marginal and postmarginal veins subequal and distinctly longer than the stigmal; abdomen shining, strongly compressed, the fourth tergite not more than half as long as the third, second and third subequal and rather large; sides of segments 2, 3, and 4 closely finely punctate except along the posterior margins; stylus rather prominent. Black; antenna entirely black; front tibiae and all tarsi testaceous; middle and hind tibiae dark brown, paler at apices; abdomen ventrally more or less piceous.

Type-locality.—Hindupur, Anantapur Dt., India.

Type.—Cat. No. 22284, U.S.N.M.

Two females collected by Ramakrishna Ayyar, 12–V–1914. The paratype female with head and fore legs missing.

Family CHALCIDIDAE.

CHALCIS ARGENTIFRONS Ashmead.

Eight specimens determined as this species are labeled: "Parasite on Lasiocampid pupa. Coimbatore, South India. Insectary. August 1, 1914." The species was originally recorded from the Philippine Islands.

STOMOCERAS AYYARI, new species.

Female.—Length, 8 to 9 mm. Whole insect, including the legs and antennae, black; wings hyaline basally, faintly infuscated apically with a dark brown spot behind the marginal and apex of submarginal veins, this spot extending posteriorly not quite to the middle of the wing; also two long narrow longitudinal streaks of brownish, one from the stigmal vein and the other from the hind margin of the brown spot. Head strongly punctate; scrobicular depression broad and

deep, coarsely punctate laterally, coriaceous medially, bounded by coarse carinae which meet in a curve behind the front ocellus and which are weaker below the eyes; vertex sloping and not separated from the occiput; cheeks separated from face by a smooth carinate ine; antenna 11-jointed, slender, separated at base by a strong keel; scape and pedicel as well as the funicle and club opaque; pedicel about twice as long as the subquadrate third joint and very slightly shorter than or subequal to the fourth joint; joints beyond the fourth gradually shortening, the tenth subquadrate and very slightly longer than the third; club solid, conic ovate and about twice as long as the tenth joint; pronotum with coarse thimble-like punctures, its sides separated from the declivitous anterior portion by a sharp carina which fades out dorsally; the posterior margin of pronotum unarmed; mesoscutum and scutellum sculptured like the pronotum, the scutellum carinately margined and terminating apically in a broad projection which is bidentate at apex; mesopleura coarsely longitudinally striate above, smooth on lower one-third; metanotum with coarse longitudinal striation; propodeum rugoso-punctate, with a short, blunt angulation just posterior to the spiracle, a distinct carina on each side arising just mesad of the spiracle and extending to the base of abdomen and two parallel longitudinal carinae medially which are separated by a distance about equal to that between the apices of the two teeth on the scutellum; margin of the posterior femora beneath with two broad shallow emarginations and finely denticulate for about two-thirds the length of femora; abdomen about as long as head and thorax, the first tergite the largest; first to fifth tergites above with a broad apical border, finely closely punctate, smooth basally; sides of tergites with much coarser punctures; sixth tergite coarsely uniformly punctate all over; seventh compressed into a keel above and coarsely punctate on the sides only. Male unknown.

Type-locality.—Coimbatore, South India.

Type.—Cat. No. 22285, U.S.N.M.

Described from four females labeled: "Parasite from *Parasa lepida* cocoons. 16–XII–1914."

Named in honor of Ramakrishna Ayyar, acting government entomologist, Madras Agricultural College, Southern India, from whom the specimens were received.

Family ENCYRTIDAE.

Subfamily EUPELMINAE.

Genus NEANASTATUS Girault.

Neanastatus GIRAULT, Bull. Wisconsin Nat. Hist. Soc., vol. 11, 1913, p. 35.
Solindinelleus GIRAULT, Soc. Ent. Jahrg., vol. 29, 1914, p. 22.

In the opinion of the writer *Neanastatus* and *Solindinelleus* are synonyms. The former genus is founded on the female sex, while

the latter, although said to have been founded on a female, is believed to be based on a male. The author of the genus[1] writes that *Solindinelleus* is "like *Neanastatus*, excluding the shape of the abdomen." His description of the abdomen of *S. pulchricorpus* strongly suggests a male and agrees in every particular with males received from India, where they were associated with galls, as was the genotype specimen. Associated with the male from India are females which undoubtedly belong to *Neanastatus*.

(SOLINDINELLEUS) NEANASTATUS PULCHRICORPUS (Girault).

Two males and three females of what are believed to be this species are labeled: "Coimbatore, South India. From gall. T. V. R., collector. June 18–25, 1913." As stated above the description of the species is said to have been based on a female, while this determination is based on the belief that the description is of a male. Until the sex of the type is definitely determined, therefore, this determination will of necessity remain doubtful.

NEANASTATUS TROCHANTERICUS, new species.

Female.—Length, 3.5 mm. Vertex and frons opaque, with close shallow thimble-like punctures; face below antennae and cheeks finely lineolated; antenna slender, the club thickened; scape equal in length to the pedicel, ring joint, and first funicle joint combined; pedicel obconic, about twice as long as thick at apex; ring joint strongly transverse; first funicle joint two-thirds the length of scape, second funicle joint one-half as long as scape, third nearly four-fifths the length of second, fourth slightly more than half as long as the second, fifth very slightly less than half as long as the second, and about one-fifth longer than thick; club a little longer than funicle joints four and five combined, 2-jointed, obliquely truncate, the apical joint much longer than the basal one; pronotum conically produced, as long as the mesoscutum and with faint scalelike sculpture; mesoscutum, tegulae, and scutellum sculptured like the pronotum, the mesoscutum depressed down the middle, and the scutellum with a deep median groove; sides of pronotum and mesopleura finely lineolate-reticulate; the posterior half of mesopleura very finely longitudinally striate; forewing long and rather narrow, strongly infuscated from a short distance proximad of the stigmal vein outwardly to the apex, the apex somewhat lighter, rest of the wing hyaline; postmarginal vein at least four or five times as long as stigmal; legs long and slender, the middle pair especially long, as long as the whole insect or very nearly; the median trochanter with a short but distinct spinelike process dorsally; middle tibiae outwardly with short black bristles along either margin and terminating apically

[1] Memoirs Queensland Museum, vol. 4, 1915, p. 35.

in a comb of short black spines, middle tibial spur as long as the three basal joints of tarsi combined, the basal joint of tarsus with a single row of black spines beneath; abdomen slender, distinctly longer than the head and thorax, subcompressed and conical, the ovipositor sheaths barely showing at apex. General color light orange-yellow; antennae, vertex and frons, transverse blotch on the occiput, posterior margin of pronotum medially more or less, tegulae apically, scutellum, posterior femora and tibiae, and apical four joints of the fore and middle tarsi brownish-testaceous or fuscous; basal joint of hind tarsi white, apical four joints black; abdomen with two broad blackish bands, one some distance before the middle, the other before the apex; sometimes with an obscure brownish band near base and another between the two blackish bands. Male unknown.

Type-locality.—Coimbatore, South India.

Type.—Cat. No. 22286, U.S.N.M.

Described from four females labeled: "Parasite from galls on *Ischaemum ciliare*. Y. R., collector, 25–XI–1915." One of the paratypes has lost the abdomen. Antenna of the type mounted on Hymenoptera slide No. 883, U.S.N.M.

Subfamily ENCYRTINAE.

APHYCUS FUSCIDORSUM, new species.

In Timberlake's key to the species of this genus, this species runs best to *coquillettii* Howard, but differs from that species in antennal characters, as well as in the color of mesonotum and antennae. Could also be run to *alberti*, but differs in color of mesonotum and legs as well as in the antennae.

Female.—Length, 0.8 mm. Front and vertex not quite twice as long as broad and granularly opaque; ocelli in an acute angled triangle, the posterior pair about one-fourth their own diameter from the eye-margin; antennal scrobes deep and rather narrow, the frons prominent. Scape widest at about the middle, one-third as broad as long; pedicel shorter than the first two funicle joints combined; first four funicle joints subequal and fully as long as broad or a little longer than broad, the fifth and sixth joints subequal and subquadrate and wider than the fourth; club ovate, a little broader than the funicle and about equal in length to the three preceding funicle joints combined. Wings closely uniformly ciliated, not broad; oblique hairless streak interrupted posteriorly; mesoscutum and scutellum finely sculptured, opaque. Frons and vertex brownish yellow; dorsal portion of pronotum whitish with a brown dot at each lateral angle; remainder of dorsum of thorax and abdomen dark fuscous except that the margins of scutellum and a broad margin on abdomen are pale yellowish; the mesoscutum and scutellum covered with fine whitish

hairs; underside of head, thorax, and abdomen pale brownish yellow; tegulae pale; legs concolorous with the underside of the body, the tibiae each with two very obscure, scarcely noticeable, brownish bands or spots and the apical tarsal joint brownish. Scape with an oblique blackish spot in middle; pedicel blackish basally; basal half of club blackish; rest of antennae pale yellowish.

Type-locality.—Coimbatore, South India.

Type.—Cat. No. 22287, U.S.N.M.

Described from four female specimens labeled: "Parasite on scales on Lab-lab. Insectary. 9–X–1914." The host plant is probably one of the hyacinth beans belonging to the genus *Dolichos*.

ANICETUS CEYLONENSIS Howard.

Three female specimens are labeled: "Parasite on scale on Lab-lab. Coimbatore, South India. Insectary." Compared with the type By "Lab-lab" is probably meant one of the hyacinth beans belonging to the genus *Dolichos*.

PARACOPIDOSOMOPSIS JAVAE Girault.

Seven specimens labeled: "Parasite of *Plusia signata* on Ragi, Coimbatore, South India," have been compared with the Girault types which were reared from *Plusia*, sp. from Salatiga, Java. The Indian specimens are indistinguishable from the Javanese.

EUCOMYS LECANIORUM Mayr.

Nine specimens of what appear to be this species are labeled: "Parasite on *Lecanium* on cotton. Coimbatore, South India. Y. R. coll." These specimens were compared both with Mayr's description and with a specimen determined as *E. lecaniorum*, reared from *Lecanium hesperidum* from Portici, Italy.

Family PTEROMALIDAE.

EUPTEROMALUS PARNARAE, new species.

Very close to *Eupteromalus nidulans* (Foerster) Kurdjumov, but differing by being much lighter green in color.

Female.—Length, 2 mm. Head, thorax, abdomen, and coxae green, the coxae more or less diluted with yellowish inwardly, the middle pair mostly yellowish; antennal scape and legs, except coxae, pale reddish testaceous; antennal flagellum dark brown; wings hyaline, the venation and tegulae pale. Head and thorax with close irregular thimble-like punctation; cheeks and clypeus with fine converging striae; occiput delicately carinately margined; antennal pedicel about equal to the two ring joints and first funicle joint combined; first funicle joint very slightly longer than broad, the following funicle joints subequal and subquadrate; club 3-jointed and about as

long as the three preceding funicle joints; pronotum short, the dorsal portion smooth posteriorly, punctate along the anterior margin, the declivitous portion reticulated and separated from the dorsal portion by a weak carina; mesoscutum and scutellum sculptured like the vertex; propodeum between the lateral folds sculptured like the scutellum, with a very delicate median carina which is absent in some specimens, the lateral folds very distinct and complete; neck of propodeum large and sculptured a little more coarsely than the area in front of it; abdomen conic-ovate, as long as the thorax, smooth and polished, the first segment comprising approximately one-third of its length; postmarginal vein nearly as long as the marginal and distinctly longer than the stigmal.

Type-locality.—Karvetnagar, South India.

Type.—Cat. No. 22288, U.S.N.M.

Described from ten females labeled "Parasite on *Parnara mathias* on Paddy. 7–XII–1914."

MERAPORUS VANDINEI Tucker.

Eight specimens, labeled "Par. on *Sitodrepa* on Coriander, April 4, 1918, Madras I. R. 41," have been compared with the types of *vandinei* and found to be indistinguishable. Also six specimens of the same species, labeled "From maize seeds Coimbatore, Ramakrishna Coll." The latter specimens were evidently reared from the same lot of material as the type specimen of *Eurytoma denticoxa*, described elsewhere in this paper.

The original types of *vandinei* were reared from corn and rice infested by *Calandra oryza* at different points in Texas and Louisiana.

BRUCHOBIUS COLEMANI Crawford.

Three specimens, labeled "Coimbatore, South India, from Red Gram pods. Y. R. coll." *Bruchobius colemani* was originally described as a parasite of *Bruchus chinensis* from Mysore, India. The name "red gram" is said by Mr. W. E. Safford, of the United States Department of Agriculture, to be applied in South India to *Vigna sinensis*, the seeds and pods of which are edible.

Superfamily SERPHIDOIDEA.

Family PLATYGASTERIDAE.

POLYGNOTUS, species.

Five specimens, labeled "Pudukota. Parasite on Anaikombon. 28–XI–1914."

TELENOMUS COLEMANI Crawford.

Nine specimens of this species are labeled "Parasite on Pentatomid eggs. Coimbatore, South India."

XESTONOTIDEA, new name.

Xestonotus FOERSTER, Hym. Stud., vol. 2, 1856, p. 107 (preoccupied by *Xestonotus* LeConte, Trans. Amer. Philos. Soc., vol. 10, 1853, p. 383).

Since the original description of *Xestonotus* Foerster, which was described without included species, two species have been referred to the genus. In each case, however, the author has questioned the correctness of his placement of the species. Neither *Xestonotus andriciphilus* Ashmead nor *X. meridionalis* Brues, therefore, are eligible for designation as type of the genus. The following new species agrees with Foerster's characterization. It is accordingly named as the type of *Xestonotus* Foerster and automatically becomes type of the new generic name.

Type of the genus.—*Xestonotidea foersteri.*

XESTONOTIDEA FOESTERI, new species.

Female.—Length, 1.5 mm. Head transverse as viewed from above; lateral ocelli slightly less than their own diameter from the eye-margin, more distant from the front ocellus; head viewed from in front a little broader than long; frons smooth and polished with a few transverse striae just above the antennae; occiput and the vertex behind finely transversely striated; antennae inserted at the clypeus, 10-jointed; scape long, slightly swollen beyond the middle; pedicel twice as long as the third antennal joint, and a little longer than the fourth; fifth subequal to the fourth; sixth and seventh subequal to each other and slightly shorter than the fourth; eighth and ninth equal to each other and as long as the fourth; tenth a little longer than the pedicel; joints 7 to 10 somewhat thicker than the preceding joints, but not forming a well-differentiated club; thorax ovoid, the mesonotum polished, with distinct, complete parapsidal grooves, which are slightly convergent; scutellum smooth, sparsely hairy, longer than broad, ovate, unarmed; propodeum short, elevated into a sharp carina on each side of a rather narrow smooth medial depression; wings extending beyond the apex of abdomen; legs moderately long, all femora club-shaped, thickened toward the apex; hind tarsi distinctly longer than their tibiae; abdomen as long as the head and thorax, broadest beyond the middle, the first tergite as broad as long with a distinct longitudinal carina on each side of a median groove and more or less depressed laterad of these carinae; second tergite large, constituting nearly two-thirds the total length of abdomen, basally with a distinct longitudinal fovea on each side of the middle and a shallower median one. Head, thorax, and abdomen black; antennal scape and pedicel and all legs except their coxae rufotestaceous; antennal flagellum black, the basal joints more or less brownish. Male unknown.

Type-locality.—Coimbatore, South India.

Type.—Cat. No. 22289, U.S.N.M.

Described from one specimen labeled "Parasite from galls on *Ischaemum ciliare.* 26–XI–1915. Y. R., coll."

A MOUNTED SKELETON OF DIMETRODON GIGAS IN THE UNITED STATES NATIONAL MUSEUM, WITH NOTES ON THE SKELETAL ANATOMY.

By Charles W. Gilmore,

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INTRODUCTION.

During the spring of 1917 the United States National Museum acquired from Mr. C. H. Sternberg, a small collection of vertebrate fossils, which he and his son Levi had made earlier in the season from the Permian formation as exposed in the vicinity of Seymour, Baylor County, Texas.

The collection consists of a very fine skeleton of *Dimetrodon gigas* Cope, several hundred bones of the smaller species of *Dimetrodon*, and between 35 and 40 skulls and partial skeletons of the smaller reptilian and batrachian forms that comprise this interesting fauna.

The greater part of the collection was obtained from a deposit of bones on the Craddock ranch, discovered in 1909 by members of an expedition from the University of Chicago. In writing of this discovery, Doctor Williston[1] designated it as the "Craddock Bone Bed," and I quote below from his remarks on the manner of occurrence of the fossils found there.

> The bones in this deposit extend through a thickness of about 1 foot over a considerable space, a few hundred square feet, imbedded in red clay like that of the Cacops bed. They are unlike those of the Cacops bed, however, for the most part isolated and generally more or less free from incrusting matrix, and usually in the most perfect preservation. Not a few, however, show effects of erosion, as though they had been rolled upon a beach of hard, shallow bottom.

The skeleton of *Dimetrodon gigas*, as so often happens in deposits of fossil bones, was the one exception to the general conditions prevailing there in that considerable portions of the skeleton were found articulated, and the association of these articulated and other parts as pertaining to a single individual was further indicated by an adhering matrix which cemented them together into compact masses. For example, the skull was found disarticulated, but its separate elements with the jaws were bound into one mass by the enclosing

[1] Williston, S. W., American Permian Vertebrates, pp. 5-7, 1911.

matrix. The articulated left fore limb and foot was attached by matrix to the string of anterior dorsal vertebrae, and to a mass of thoracic ribs. Some few of the posterior vertebrae were found isolated but not far removed from the articulated series.

This specimen No. 8635, U.S.N.M., as finally assembled has the following bones present: Greater portion of skull; both rami of the lower jaws; representative parts of each of the complete presacral series of 27 vertebrae; first caudal; several complete and parts of most of the other ribs of both sides; left scapula, coracoid, procoracoid, and clavicle; left humerus, radius, ulna, and foot; left femur and tibia. The vertebrae except for the loss of four centra in the anterior dorsal region are quite perfectly preserved.

The sacrum has been supplied from a second individual, No. 8661, U.S.N.M., from the same deposit and of slightly smaller proportions. The pelvic bones and the interclavicle were kindly furnished by the late Dr. S. W. Williston from the collections of the Walker Museum. The right pelvic bones have the catalogue No. 8658, U.S.N.M.; the left is No. 8657, U.S.N.M.; the interclavicle bears the No. 8656, U.S.N.M., being the bone figured by Case in his Pelycosauria of North America (pl. 15, fig. 4). The other missing parts have been restored in plaster and painted a distinctive color.

The bones were so free from distortion that it was decided to make an open mount of the skeleton, though the difficulties of doing so were well understood. The unusual mechanical problems embodied in the mounting of a skeleton of such fragile proportions were skillfully overcome by Mr. T. J. Horne, preparator in the Section of Vertebrate Paleontology of the United States National Museum who mounted the specimen. It is the first attempt to reconstruct a free mount of an entire skeleton of a *Dimetrodon*, and the success of the undertaking may be best judged by an examination of the photographic reproduction of the skeleton here shown in Plate 70.

The pose of the skeleton was adopted after a study of living lizards and is an attitude often assumed by those land forms of the present day. The opening of the jaws to better display the rows of bristling teeth gives the animal an appearance of angrily defying one who has suddenly blocked his path.

The specimen is standing on an artificial base colored in imitation of the red clay in which the bones were originally embedded.

The total length of the skeleton from the tip of the nose to the end of the tail, between perpendiculars, is 6 feet 9 inches. From the base level to the top of the highest spine it measures 4 feet 9½ inches. Although *Dimetrodon gigas* is the largest species of the genus, the present individual is a moderate-sized representative of that species.

In plate 73 is shown a model restoration of this animal prepared by the writer and which expresses his conception of its appearance in life.

The one most striking feature of *Dimetrodon* is the high dorsal fin-like crest along the median line of the back formed by the elongation of the neural spines of the vertebrae. That in life these tall spinous processes were united by a thin membrane of skin there is little doubt, though Professors Abel and Jaekal are disposed to think the spines were covered by skin but not connected. The one living lizard which throws some light on this problem is *Basiliscus plumifrons* from tropical America (see inset plate 73), which has the crest on the back; though not so high or extensive as in *Dimetrodon*, is nevertheless supported by the elongated spinous processes of the vertebrae, and in it we have the best suggestion of the probable appearance in life of the crest in *Dimetrodon*.

In trying to account for some practical use for this unusual outgrowth, it has been suggested that it may have resembled some of the ancient vegetation, and thus served to conceal the animal as it lay in wait for its prey or for better concealment from its enemies. Prof. E. C. Case says of these:[1]

> The elongate spines were useless, so far as I can imagine, and I have been puzzling over them for several years. * * * It is impossible to conceive of them as useful either for defense or concealment, or in any other way than as a great burden to the creatures that bore them. They must have been a nuisance in getting through the vegetation, and a great drain upon the creatures vitality, both to develop them and keep them in repair.

The head of *Dimetrodon* is enormously large in proportion to the size of the body. The jaws are provided with powerful incisor and maxillary tusks, the largest of which reach a length of 3 inches. The cheek teeth are recurved, with sharp, serrate edges. There is no animal known which has a more efficient apparatus for the capture of its prey. The eyes were large and set well back and high in the head. The neck is short, the limbs are strong, having feet with 5 digits, each of which is terminated by a sharp claw. No specimen has as yet been found with a complete tail, but the rapid decrease in size of the known caudal vertebrae suggests a short tail, and it has been so restored in the mounted skeleton. The specimen here pictured in plate 70, although a representative of the largest species of the genus, is exceeded in size by several known individuals. The presence of the greater number of the ribs of both sides shows the great depth of the body cavity and the extreme flatness of the sides of the anterior part of the body. From a study of the habits of living reptiles it is known that those with compressed bodies are usually dwellers among bushes and trees. Professor Case is of the opinion that *Dimetrodon* is descended from an aquatic ancestry, and that it ranged widely over the land. It is probable that ordinarily the animal did

[1] The Permo-Carboniferous, Beds of North America and Their Vertebrate Fauna. Pub. No. 207 Carnegie Institution, Washington, 1915, p. 142.

not raise his body far above the ground, but crawled around much after the fashion of the crocodile, though, quoting again from the above author:

> The strong limbs with longer foreleg than upper leg, with strong feet, with powerful claws, ample evidence of an ability to run with some speed and perhaps even leap or pounce upon prey. Abel, in his Paleobiologie, points out that running and leaping animals have the foreleg longer than the upper leg, and creeping animals have the proportions reversed. It is not probable the *Dimetrodon* was ever capable of leaping any distance, but it certainly was able to move swiftly for a short space. Probably it lay hidden in the vegetation, and made short, scuttling rushes upon its prey, ending, possibly, with a short pounce, which permitted its weight to add something to the vigor of the attack by tooth and claw.

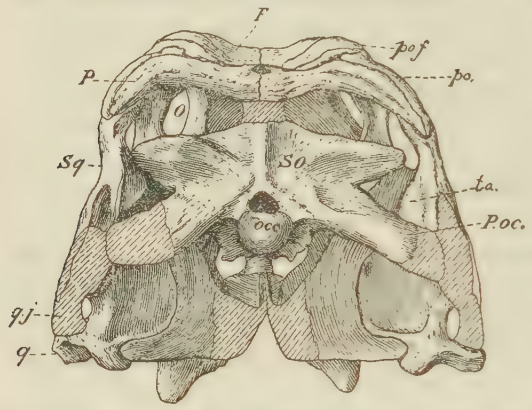


FIG. 1.—DIMETRODON GIGAS, POSTERIOR ASPECT OF SKULL. No. 8635 U.S.N.M. ONE-FOURTH NATURAL SIZE. *F.*, FRONTAL; *o.*, ORBIT; *occ.*, OCCIPITAL CONDYLE; *P.*, PARIETAL; *po.*, POSTORBITAL; *P. oc.*, PARAOCCIPITAL; *po. f.*, POSTFRONTAL; *q.*, QUADRATE; *q. j.*, QUADRATOJUGAL: *So.*, SUPRAOCCIPITAL; *Sq.*, SQUAMOSAL; *ta.*, DOUBTFUL ARTICULATION FOR THE TABULARE.

Dimetrodon was the dominant and probably the most formidable animal of his time. Of the contemporary animals of the Permian there was a vast assemblage of reptiles and amphibians, and it was these that the cruel jaws were peculiarly adapted for catching. The borders of pools and swampy places were probably the regions most densely populated by these lesser forms, and no doubt such places were the favorite haunts of the *Dimetrodon*.

NOTES ON THE SKELETAL STRUCTURE OF DIMETRODON GIGAS COPE

Skull.—Through the studies of Baur, Case, Williston, Broom, and von Huene, the structure of the skull of *Dimetrodon* is now pretty well known. There is still divergence of opinion regarding the extent of the boundaries of some few of its elements, and of the homologies of certain others. At this time it is the composition and extent of the bones forming the posterior part of the cranium that appears to be least understood, and while the skull of No. 8635, U.S.N.M., offers but little positive information for making clearer our understanding of the occipital region, it does offer suggestions which may eventually be of help in arriving at the correct interpretation of these parts.

The median bones of the occipital region were found articulated as shown in figure 1. The sutures are entirely obliterated—a con-

dition found to prevail in four other individuals in this same collection. All authorities, I think, are now agreed that this part of the occiput consists of a median supraoccipital, small exoccipitals, large paraoccipitals (opisthotics), and basioccipital. In addition to these Huene in 1913 [1] recognized a distinct dermosupraoccipital (postparietal) bone lying between the upper extremity of the supraoccipital and the parietal, and laterally a tabulare and supratemporal bones.

In assembling the bones of the present skull all of those preserved could be articulated except the one illustrated in figure 2. It was submitted to Dr. S. W. Williston, who identified it as being a portion of the tabulare and dermosupraoccipital, but I have not been able to satisfactorily articulate these bones, so they have been left off the skull until such time as their proper place shall be definitely determined.

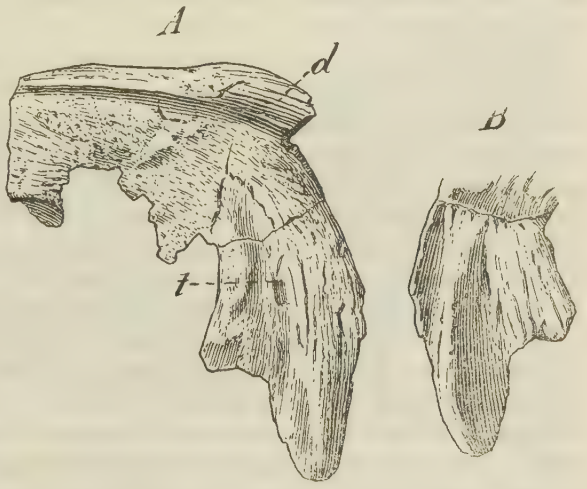


FIG. 2.—DIMETRODON GIGAS OCCIPITAL BONES NO. 8635, U.S.N.M. ¾ NATURAL SIZE. *A*, EXTERNAL ASPECT. *d*, DERMOSUPRAOCCIPITAL; *t.*, TABULARE. *B*, INTERNAL ASPECT OF CONCAVE ARTICULAR SURFACE OF TABULARE.

The squamosal shows on its medial side a convex triangular articular facet (see fig. 1, *ta*), which I first regarded as the surface for articulation with the concave area of the so-called tabulare shown in B, figure 2. These two surfaces seem to be counterparts, but unfortunately the tabulare appears to belong to the right side, while the one squamosal present pertains to the left side of the skull, so that a direct trial could not be made. Furthermore, I have never been able to orientate the bones shown in figure 2, so that their relationships with the other elements of the posterior aspect would be entirely in harmony. Another suggestion as to the use of this articular facet on the squamosal, arrived at since the skull was articulated, is that it may be for the paraoccipital process. In the event of that fact being established it would necessitate the shifting upward of the whole central mass of the occiput to a higher position. Such a change would bring the supraoccipital in contact on the ventral side with the

[1] Bull. Amer. Mus. Nat. Hist., vol. 32, 1913, p. 359, fig. 44.

parietals, as it is usually, if not always, found in the reptilia. The median superior border of the supraoccipital is not united by suture with the overlying parietals, but presents a finished grooved border for cartilagenous attachment—a condition found in many of the Predentate dinosauria.

The presence of such a border casts grave doubt on the authenticity of Huene's determination, where he depicts [1] the supraoccipital as attached by jagged suture with a dermosupraoccipital that is interposed between it and the parietals. Either the upper median portion of these coalesced occipital bones in No. 8635, U.S.N.M. (fig. 1) represent the dermosupraoccipital or else Huene's interpretation is in error. All the evidence sustains the latter conclusion, but as to how the dermosupraoccipital does articulate with the parietals the present specimen offers no evidence.

The complete, uncrushed left squamosal is present, and it appears to clear up some of the earlier determinations of authors. The upper end is obliquely truncated, presenting on the superior surface of the upper end an articular face, the outer half of which is certainly for articulation with the posterior branch of the postorbital; the inner half of this facet meets the outer end of the parietal. It should be stated, however, that the parietal was found detached, but everything about it appeared to indicate a close union with the posterior branch of the postorbital and squamosal as shown in figure 1.

There was no evidence of the separation of the posterior extremities of these bones by an interposed supratemporal bone such as found by Huene, and I think it highly improbable that such a condition existed, for were the supratemporal present in this position in *Dimetrodon*, contact between the parietal and squamosal would be severed—a most unusual condition in the reptilia.

Broom in his restoration [2] of the skull of *Dimetrodon* shows the parietal and postorbital in close apposition and both properly in contact with the squamosal. In view of the evidence now before me I can see no possibility of there being an element thrust in between the posterior extremities of these bones such as found by von Huene.

The quadratojugal is another bone whose limitations are not as yet fully and satisfactorily determined. This bone is represented in the present skull by the greater portion of the left element. It had not been identified at the time of articulating the skull, so does not appear in the illustrations. As preserved it is a small irregularly shaped bone, with a short lateral process which extended forward to overlap the posterior end of the jugal (see fig. 1, *qj*.) and a superior process which extended upward behind the quadrate to unite with the squamosal as shown in figure 1. Huene has correctly viewed the lateral extent of the quadratojugal (fig. 42, p. 357), but he appears to have been in error regarding its superior process, which he con-

[1] Bull. Amer. Mus. Nat. Hist., vol. 32, 1913, p. 359, fig. 44 A.
[2] Broom, R. Bull. Amer. Mus. Nat. Hist., vol. 28, 1910, p. 225, fig. 19.

sidered short. This process has been broken off and is missing from specimen No. 8635, U.S.N.M., but is shown restored in its entirety on the right side of the posterior aspect of the skull in figure 1. The upper extremity on the left side was purposely left out so that the artist could depict the decided depression on the posterior border of the squamosal.

If this articular depression is not for the reception of the upper end of a process from the quadratojugal, I am utterly at loss to know its function. That other specimens have obscurely indicated such an extension of this process is shown in a figure[1] of the posterior aspect of a *Dimetrodon* skull illustrated by Case, where the left element is shown extending up as high as the paraoccipital process.

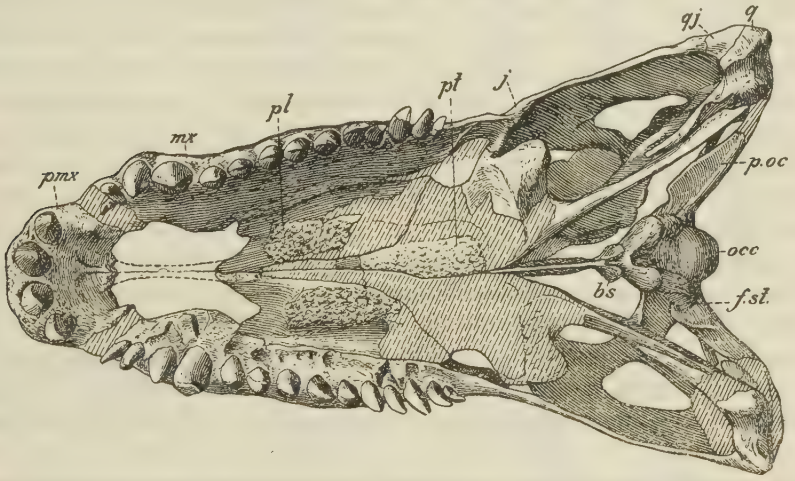


FIG. 3.—SKULL OF DIMETRODON GIGAS COPE, NO. 8635, U.S.N.M. PALATAL VIEW. ONE-FOURTH NATURAL SIZE. *bs*, BASISPHENOID; *f. st.*, FACET WITH WHICH THE STAPES ARTICULATED; *j*, JUGAL; *mx*, MAXILLARY; *occ.* OCCIPITAL CONDYLE; *pl.*, PALATINE; *pmx*, PREMAXILLARY; *p. oc.*, PARAOCCIPITAL PROCESS; *pt.*, PTERYGOID; *q.*, QUADRATE; *qj.*, QUADRATOJUGAL.

The union of the quadratojugal and quadrate on the ventral border is by an inverted V-shaped notch on the distal side of the former which fits over the outward extension of the articular portion of the latter. Immediately above this notch on the medial side is the rounded border forming the outer boundary to the foramen between these two bones.

The bones of the top of the skull are pretty well known, and the skull as restored agrees quite closely with the determinations of Case and other authorities. The septo-maxillaries are present, being found attached by matrix to the posterior end of the premaxillary. These were displaced in relation to one another, and I have been unable to articulate them with any degree of confidence of their being correctly placed.

In figure 3, I present a view of the palate of No. 8635, U.S.N.M., which in the main agrees closely with Broom's restoration of this

[1] Bull. Amer. Mus. Nat. History, vol. 28, 1910, p. 193, fig. 4.

aspect of the skull differing chiefly in the proportions of some of its elements. The anterior portion of the palatines are relatively wider than represented by Broom, and the pterygoids, especially their anterior prolongation, is clearly shown by this specimen to be narrower than in any restoration yet given. It now appears quite probable that in articulating this skull the palate especially between the maxillaries has been made too narrow, thus closing up the posterior median aperture.

Vertebral column.—The complete backbone in front of the sacrum in *Dimetrodon*, according to Dr. E. C. Case, consists of 27 vertebrae. In the present specimen there were parts present of that number of presacrals. The atlas was represented only by the preatlantal intercentrum, and vertebrae 11, 13, 14, and 15 (counting from the head backward) by their spinous processes. The other vertebrae of the series are unusually well preserved, but all except the fourth and sixth lack the proximal terminations of the spines. In articulating the skeleton the fourteenth and fifteenth have been assigned centra that were found associated with this specimen, but there is no evidence to show that they belong to these particular vertebrae. There is a single caudal present that on account of the large size of its transverse processes is called the first of the series. The missing sacral vertebrae have been supplied from a second individual (No. 8661, U.S.N.M.), belonging to the same collection and from the same deposit of fossils. It appears to pertain to a slightly smaller individual than No. 8635, U.S.N.M. With the exception of the single caudal mentioned above the remainder of the tail has been restored.

The fin-like crest along the back formed by the lengthened spinous processes of the vertebrae presents a notably different aspect than found in the previously mounted skeletons of *Dimetrodon incisivus*, but whether the differences observed represent constant features peculiar to *Dimetrodon gigas*, I am not prepared to decide at this time. Unlike *D. incisivus*, where the spines rise perpendicularly and rapidly lengthen from the axis backward, the first four posterior to that bone in this specimen are of about equal height. Beginning with the seventh of the series they rapidly grow longer as we proceed posteriorly in the column, reaching their maximum development with the twelfth vertebrae. Continuing posteriorly they gradually diminish in length, finally graduating into the short spines of the tail. The processes of the first dorsals have a tendency to rise vertically, but as we pass backward they assume an oblique and finally a curved retroverted position overhanging the sacrum.

The spinous process on the fourth cervical is complete, being terminated by a cupped extremity. It measures 220 mm. in length from center of neural canal to tip. The sixth spine is very nearly perfect, lacking only a small portion of the tip. All of the others

have suffered more or less loss from their upper ends, but none show any expansion of this end as in *Edaphosaurus;* all probably tapered to a pointed end with cupped extremity.

Several of the spines as shown in plate 71 have large exostoses showing that they have been broken and healed during life.

Ribs.—Parts of nearly all the ribs are present, of which six are complete. None were found articulated, so that their present position in the skeleton is based entirely on a study of their relative size, spread of head between capitulum and tuberculum as compared with the vertebral articulating facets. Counting back from the axis, ribs Nos. 7, 9, 10, and 11 of the right side, and Nos. 7 and 16 of the left side are perfectly preserved.

The anterior thoracic ribs when articulated form a much flattened and exceedingly deep body cavity immediately behind the forelegs. (See pl. 72, fig. 1.) More posteriorly, however, the ribs take on a decided convexity, as may be seen by comparing ribs *A* and *B*, figure 4. All of the thoracic ribs are terminated distally by slightly expanded cylindrical ends that are cupped for the better attachment of the cartilagenous ribs of the belly.

FIG. 4.—RIBS OF DIMETRODON GIGAS, No. 8635, U.S.N.M. *A*, SEVENTH RIB OF RIGHT SIDE, VIEWED FROM THE FRONT; *B*, SIXTEENTH RIB OF LEFT SIDE, (REVERSED) VIEWED FROM FRONT; *C*, MEDIAN CERVICAL RIB; *c*, CAPITULUM; *t.*, TUBERCULUM. ALL FIGURES ABOUT ONE-THIRD NATURAL SIZE.

There was no evidence of the presence of ossified abdominal ribs. The seventh pair of ribs, the longest of the entire series, measure 395 mm. in length. The sixteenth rib of the left side is 334 mm. long measured from the tuberculum over the curve.

Shoulder girdle and fore limb.—In his monographic work, "The Pelycosauria of North America," [1] page 121, Case says: "The shoulder girdle of *Dimetrodon gigas* unknown." It is, therefore, of interest to find with specimen No. 8635, U.S.N.M., the complete

left half of this girdle articulated with the almost perfect limb and foot. (See pl. 72, fig. 2.)

I have carefully compared these bones with the homologous elements of the smaller and better known species, *Dimetrodon incisivus*, but, except for their larger size, fail to detect differences which might be of help in distinguishing them specifically.

FIG. 5.—LEFT SCAPULA OF DIMETRODON GIGAS COPE, NO. 8635, U.S.N.M. ABOUT ONE-THIRD NATURAL SIZE. LATERAL VIEW. *cf.* CORACOID FORAMEN. *cor.*, CORACOID; *mcor.*, METACORACOID.

Scapula.—The unusually well-preserved left scapula coossified with the coracoid and metacoracoid is known in figure 5.

The suture defining the junction of scapula and coracoid has been entirely obliterated, but between the coracoid and metacoracoid it remains distinct as shown in figure 5.

From end to end there is a decided convex curvature which conforms well to the form of the body and also throws the expanded

coracoid end somewhat inward to form the chest. The greatest length of these coossified bones is 410 mm. measured over the curve. Greatest expanse of distal end, 235 mm.; of proximal end, 140 mm.

No cleithrum has been restored in the mounted skeleton as no bones which could be referred to this element were found in the collection.

The humerus of *Dimetrodon gigas* can only be distinguished from *D. incisivus* by its much larger size. Case [1] observes that in the humerus of the type of *D. gigas* "differs from *Dimetrodon incisivus* in the articular face, which involves the whole of the proximal end, and the radial crest, which, while being strong is not long, beginning lower down on the head and not continuing so far distally.

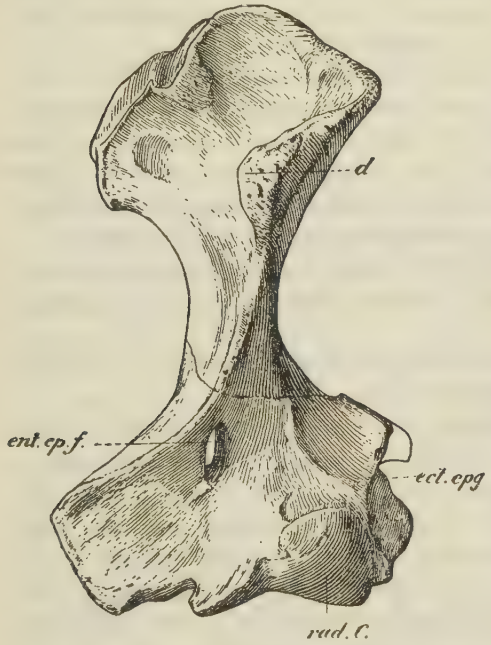


FIG. 6.—LEFT HUMERUS OF DIMETRODON GIGAS COPE, NO. 8635, U.S.N.M. ONE-THIRD NATURAL SIZE. ANTERIOR OR VENTRAL VIEW. *d.*, RADIAL OR DELTOID CREST; *ect. epg.*, ECTEPICONYLAR NOTCH; *ent. ep. f.*, ENTEPICONDYLAR FORAMEN; *rad. C.*, RADIAL CONDYLE.

FIG. 7.—LEFT RADIUS AND ULNA OF DIMETRODON GIGAS COPE., NO. 8635 U.S.N.M. *A.* RADIUS VIEWED FROM THE FRONT. *B.* ULNA VIEWED FROM THE FRONT. *o.*, OLECRANON PROCESS. BOTH FIGURES ONE-THIRD NATURAL SIZE.

The edges of the proximal end are quite rugose." I fail to observe any such differences. There are 16 *Dimetrodon* humeri, large and small, in the United States National Museum collection, and though they were found to differ in some minor details all were essentially alike.

The greatest length of the present humerus is 235 mm.; greatest width of the proximal end 128 mm.; greatest width of distal end 136 mm.; least diameter of shaft 29 mm.

The *radius* and *ulna* have also been carefully compared and as with the humerus, their larger size is the chief difference found. The principal features of these bones are shown in figures 6 and 7.

[1] Publication No. 207, Carnegie Institution, Washington, 1915, p. 121.

The ulna has a greatest length of 236 mm.; greatest diameter of proximal end, 68 mm.; greatest diameter distal end, 41 mm.

The radius has a length of 190 mm.; greatest diameter proximal end, 50 mm.; greatest diameter distal end, 48 mm.

According to Case the femur of *Dimetrodon gigas* has a heavier outer condyle and a slightly curved shaft, which distinguishes it from *D. incisivus*. I fail to note any difference except that of size in the femur of No. 8635, U.S.N.M., when compared with femora of *D. incisivus*. The femur has a greatest length of 240 mm.; greatest width of distal end, 90 mm.; of proximal end, 79 mm.; the least width of shaft, 26 mm.

Like the femur the tibia shows no characters peculiar to this species. The greatest length of the tibia is 195 mm.

Carpus and forefoot.—The left forefoot of specimen No. 8635, U.S.N.M., appears to be the most complete manus of a *Dimetrodon* that has yet been discovered, and the first to be described of the species *D. gigas*. Fortunately the greater number of the bones comprising it were found articulated, thus giving positive evidence of their proper association and arrangement as shown in figure 8.

Case,[1] it appears, was the first to figure and describe the articulated carpus and portions of attached metacarpus of this genus, based on a *D. incisivus* foot.

In 1911 Williston [2] published a figure of an articulated carpus of this same species giving an anterior view.

These references cover practically all that has been written on the feet of *Dimetrodon*. The hind feet are as yet practically unknown.

The carpus in the present specimen is complete except for the element designated by Case the "sesamoid," which articulates with well-defined facts on the radiale side of centrale 2 and carpale 1. It has been restored here (see *s*, fig. 8) after an element belonging with a forefoot of *D. incisivus* kindly loaned me by Dr. S. W. Williston. Metacarpals 3, 4, and 5 and proximal phalangials 1 and 2 of digits 4 and 5 were found articulated or so little displaced as to raise no doubt as to their being in proper sequence. Other bones that were detached but found associated in the same field packages were metacarpal 1, proximal phalangials of digits 1, 2, and 3, and two ungual phalanges, here arbitrarily placed on digits 4 and 5. (See fig. 8.) All of these detached elements probably pertain to this foot, but of phalangial 2 of digit 2 and coossified phalangials 2 and 3 of digit 3, and the unguals of the first three digits, one can not be so sure they pertain to this same individual. However, the final test of the correctness or incorrectness of the association of these elements as

[1] Case, E. C. Journ. of Geology, vol. 11, No. 1, p. 11, 1903, and Pelycosauria of North America, Carnegie Institution, Pub. No. 55, 1907, pp. 113–114, pl. 16, fig. 1.

[2] Williston, S. W. American Permian Vertebrates, 1911, pl. 7, fig. 8.

illustrated in figure 8 must await the discovery of a more complete articulated manus.

The carpus of *Dimetrodon* as known at this time consists of 11 elements, though Williston is of the opinion that a pisiform [1] will be found articulating in the interval between the ulna and ulnare, as in modern reptiles and as it does in *Varanosaurus*, *Casea*, *Limnosceles*, and *Trispondylus*.

The proximal row consists of three bones (the radiale, intermedium, and ulnare), a median row of two centrale, and a distal row of five carpale. These carpal bones articulate with one another by well-defined facets and with the metacarpals by equally well-developed articular faces, which indicate clearly the spreading nature of the digits and especially the decided divergence of digit 5.

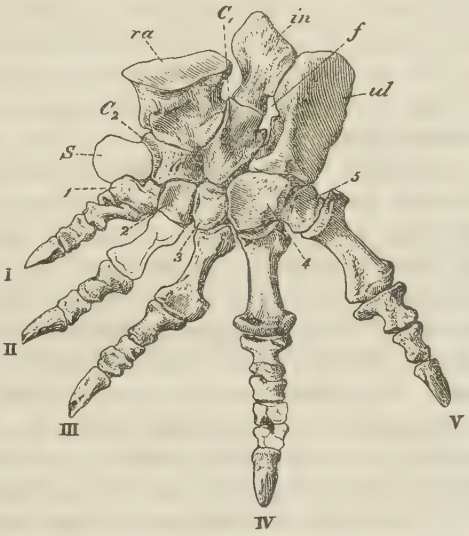


FIG. 8.—LEFT FORE FOOT OF DIMETRODON GIGAS COPE, NO. 8635, U.S.N.M. ONE-THIRD NATURAL SIZE. C_1, C_2, CENTRALE 1 AND 2; *f*, INTRACARPAL FORAMEN; *in*. INTERMEDIUM; *ra*, RADIALE; *S*, SESAMOID; *ul*, ULNARE; 1, 2, 3, 4, AND 5 CARPALE 1 TO 5; I, II, III, IV, V, DIGITS 1 TO 5.

The *radiale* is a stout block-like bone with a flattened proximal end which articulates with the radius. The distal end is wedge-shaped, formed by two nearly equal but oblique articular faces. The outer face meets centrale 2 (C_2), the inner articulates with centrale 1 (C_1). The posterior side of the radiale is channeled by a deep vertical groove running from top to the bottom.

The ulnare is a relatively thin but elongate element, broadly grooved vertically on the posterior side. The subconvex articular proximal end forms the chief articulation of the foot with the ulna. The flattened distal end unites with carpale 4 and 5; most extensively with the former. On the radial side are two distinct articular facets—the upper for the intermedium, the lower unites with centrale 1. The rounded border between these two facets represent the ulnare boundary of the very large intracarpal foramen such as is found in *Sphenodon*. This is considered by Osborn to be a "primitive feature [2] characteristic of other Diapsida."

[1] Williston, S. W. American Permian Vertebrates, 1911, p. 103.
[2] Bull. Amer. Mus. Nat. Hist., vol. 23, p. 269, 1907.

Between the radiale and ulnare is the *intermedium*, which projects well above the proximal ends of those bones, thus interposing itself between and separating the distal ends of the radius and ulna. The inner side of the proximal end articulates with the ulna much as in *Sphenodon*. Above the flat distal end that articulates exclusively with centrale 1 the shaft of the intermedium is constricted, but higher it again expands into a thin plate, being terminated by a bluntly pointed proximal extremity.

On the ulnar side an elongated facet articulates with the ulnare. In the present carpus there is no direct contact between the intermedium and the radiale—a peculiarity which appears to be distinctive of *Dimetrodon* and which differs from all other Permian reptilia. The illustrations of the carpus as published by Case [1] and by Williston [2] certainly give the impression that these bones were in contact in *Dimetrodon incisivus*, but an examination of a carpus of this species shows the same condition prevails as in the specimens here illustrated in figure 8.

Centrale 1 (C_1) has a wedge-shaped proximal end presenting two articular faces; the outer, which is the larger, unites with the radiale; the inner with the intermedium. A slight notch on the ulna side is the contribution of this bone to the boundary of the intracarpal foramen. Below this notch an elongated vertical facet meets the ulnare, while on the opposite side it unites with centrale 2, there being a small foramen at the point where the radiale and the two centrale meet. The distal end is in contact with carpale 3 and 4.

Centrale 2 (C_2) is smaller than C_1. Distally it articulates with carpale 1, 2, and slightly with 3. On the radial side there is a distinct articular facet for the "sesamoid," here restored.

Of the distal row composed of five carpale, carpale 4 is the largest. The first is expanded transversely and presents at its distal extremity a peculiar articulation for metacarpal 1, the external half being on the ventral side, the internal half being on the anterior border. The articular surfaces on carpale 2, 3, 4, and 5, which meet their respective metacarpals are broadly concave from front to back.

Digits.—The metacarpal of the first finger is very small and the finger is very short. The metacarpals gradually lengthen toward the outer side of the foot, reaching their maximum development in the fourth, which, as in *Varanosaurus*, is the longest toe of the foot. The fifth toe is divergent, as clearly indicated by the articular surface of carpale 5.

The digital formula remains to be definitely determined, though there is every reason to believe it to be 2, 3, 4, 5, 3, as here illustrated and as it exists in most primitive reptilian forms.

[1] Case, E. C. Pelycosauria of North America, Carnegie Institution, Pub. No. 55, 1907, pp. 113, 114, pl. 16, fig. 1.

[2] Williston, S. W. American Permian Vertebrates, 1911, pl. 7, fig. 8.

The proximal row of phalanges, except on digit 1, have widely expanded proximal ends and much narrower distal extremities. The distal articulation is peculiar in having a blunt median projection which is received in a median notch provided for it on the proximal ends of the succeeding phalanges. The toes are terminated by strong, clawed terminal phalanges that were cased in strong claws. The whole structure of the carpus and other bones indicates a strong, flexible foot, such as would be possessed by a carnivorous terrestrial animal.

EXPLANATION OF PLATES.

Plate 70.

Mounted skeleton of *Dimetrodon gigas* Cope. No. 8635, U.S.N.M. Viewed from the left side. About one-twelfth natural size. Mounted by Thomas J. Horne, 1918.

Plate 71.

Skeleton of *Dimetrodon gigas* Cope. No. 8635, U.S.N.M. About one-twelfth natural size. Those parts shown in outline are missing. The sacrum of three vertebrae, pelvis, and interclavicle bones have been introduced from other individuals.

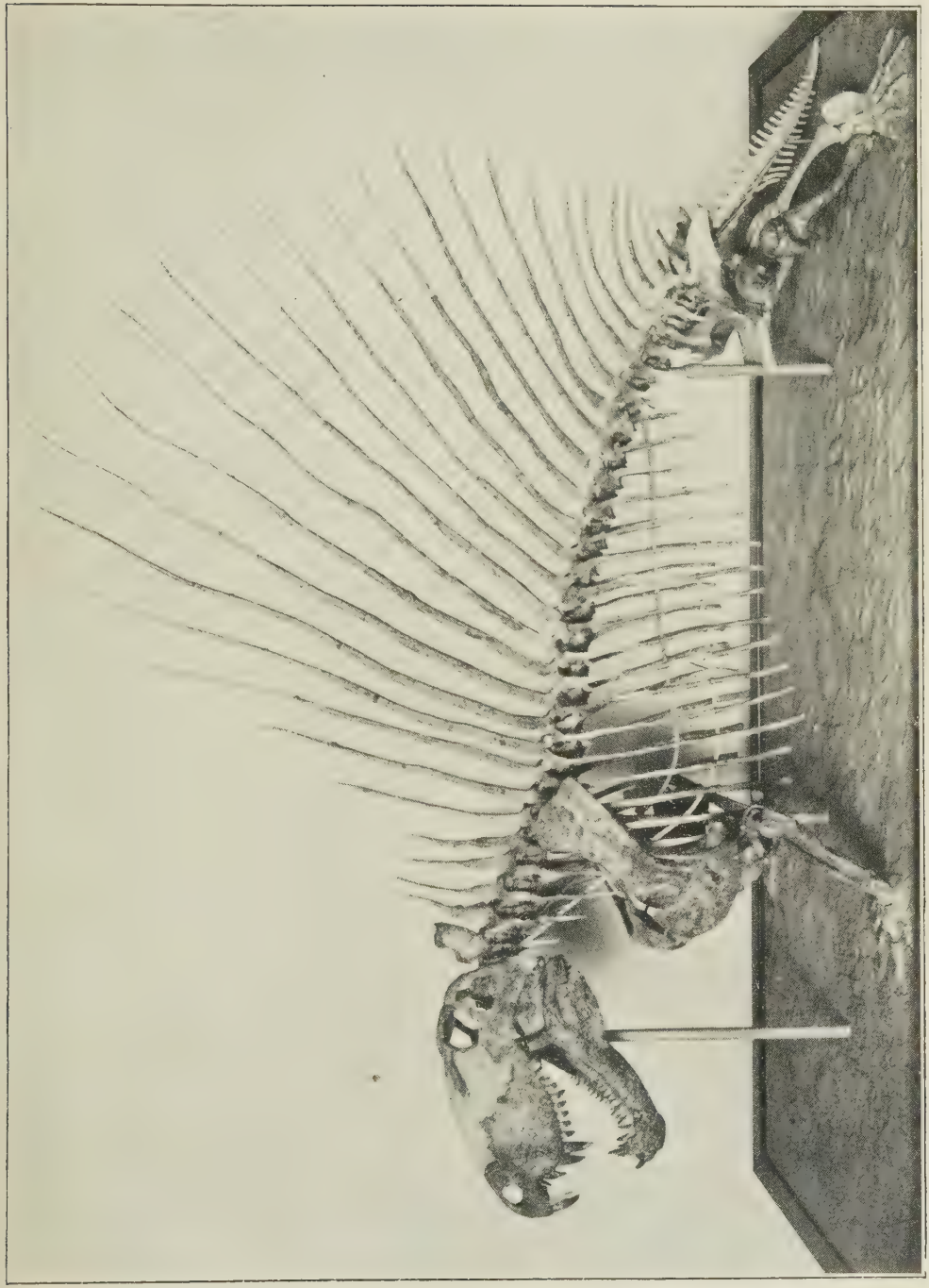
Plate 72.

Fig. 1. Mounted skeleton of *Dimetrodon gigas* Cope. No. 8635, U.S.N.M. Viewed from the rear in order to show the shape of the body cavity and the pose of the fore limbs.

Fig. 2. Mounted skeleton of *Dimetrodon gigas* Cope. No. 8635, U.S.N.M. Viewed diagonally from the left side, in order to show the articulated pectoral girdle.

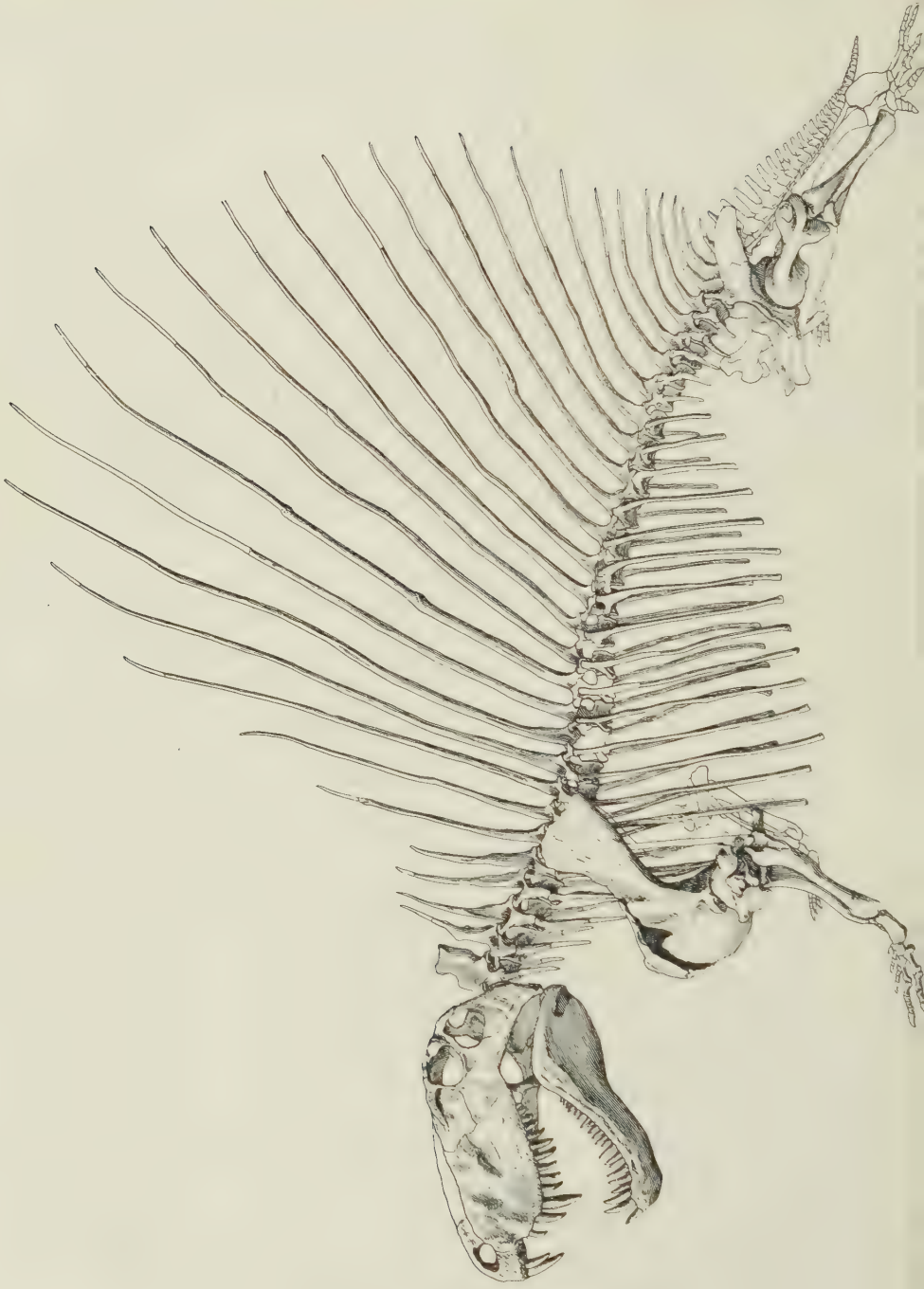
Plate 73.

Model restoration of *Dimetrodon gigas* based on the mounted skeleton shown in plates 70 and 72. About one-twelfth natural size. Modeled by Charles W. Gilmore, 1918. Inset is *Basiliscus plumifrons* a living lizard, found in Central America, which has a fin-like extension of the neural processes as in *Dimetrodon*. About one-third natural size. After Cope.



MOUNTED SKELETON OF DIMETRODON GIGAS COPE

FOR EXPLANATION OF PLATE SEE PAGE 539



SKELETON OF DIMETRODON GIGAS COPE

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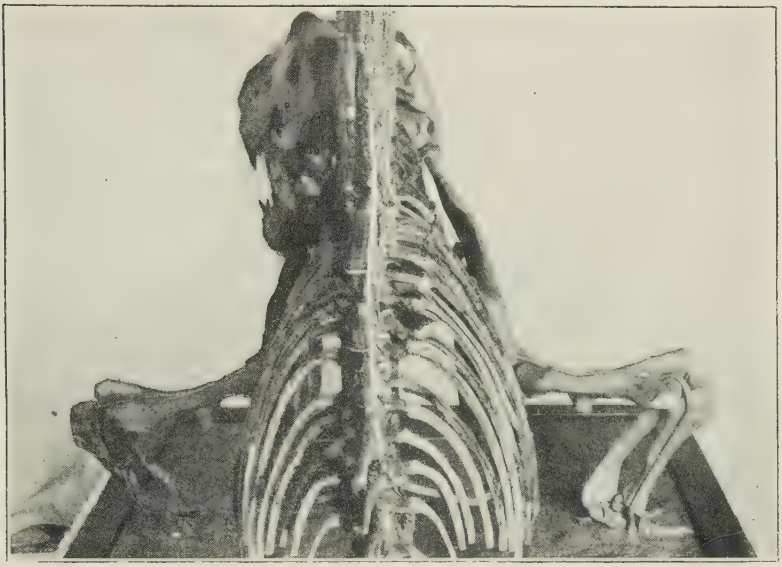
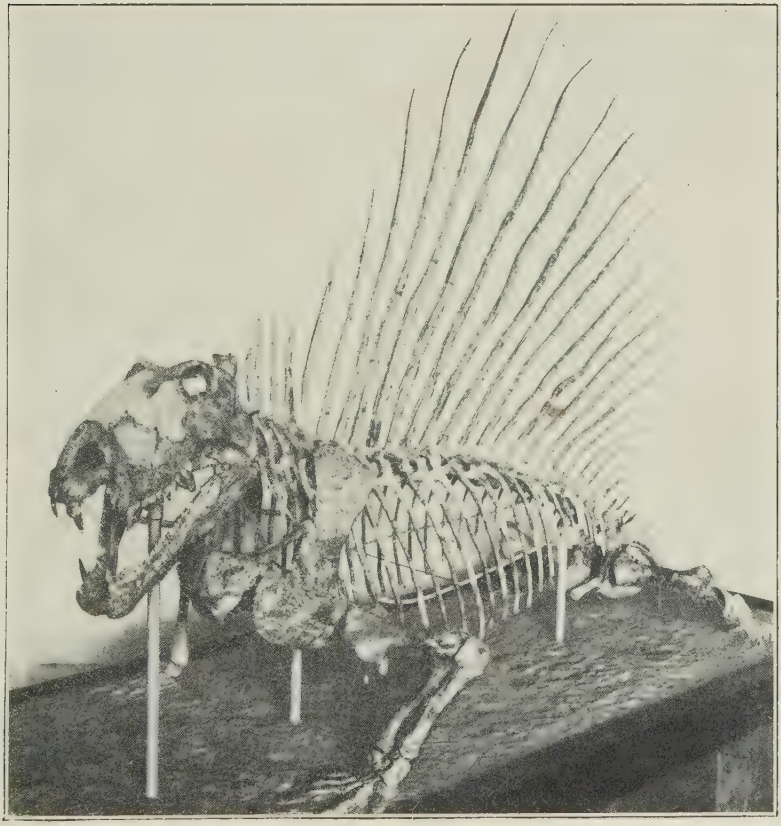


1. SKELETON OF DIMETRODON GIGAS FROM THE REAR



2. SKELETON OF DIMETRODON GIGAS, VIEWED DIAGONALLY

FOR EXPLANATION OF PLATE SEE PAGE 539

RESTORATION OF DIMETRODON GIGAS COPE

FOR EXPLANATION OF PLATE SEE PAGE 539

NEW GENERA AND SPECIES OF MUSCOID FLIES.

By Charles H. T. Townsend.
Custodian of Muscoid Diptera, United States National Museum.

In the following descriptions the position of hind crossvein is stated with reference to its relative distance from the small crossvein and the cubitus as nearer to one or the other, or in the middle between them.

The holotypes of all the new species described are in the United States National Museum, excepting only those of *Trochiloglossa tropica, Myothyriopsis bivittata,* and *Neoerigone cinerea,* which are in the American Museum of Natural History; while paratypes of the last two are in the National Museum.

The forms are arranged systematically under tribes, to conform with the arrangement adopted in synoptic tables of muscoid genera which it is hoped may be published within the year.

Tribe MUSCININI.

NEOMUSCINA, new genus.

Genotype.—Neomuscina cavicola, new species.

Differs from *Muscina* as follows: Clypeus strongly dished. Arista much longer than antennae, thinly plumose. Female frontalia without convergent pair of bristles in front of ocelli. Cheeks not as wide as epistoma. Only one preacrostichal bristle. Scutellum subpointed behind. Basal segment of abdomen well shortened, the anal segment little longer than preceding segment. Third segment with a marginal row of erect bristles.

NEOMUSCINA CAVICOLA, new species.

Length, 7 mm. Numerous specimens of both sexes, but largely males, from the Santa Catalina, Chiricahua, Graham, and Pinal Mountains, and the East Verde River, all Arizona, 3,500 to 5,500 feet. (C. H. T. Townsend); and females from Las Vegas Hot Springs, New Mexico (H. S. Barber). The males especially congregate in quantity during the day in caverns and under overhanging rocks in the canyons, often entering the tent at night.

Pale fulvous to straw-color. Head silvery. Frontalia and antennae smoky rufofulvous. Palpi fulvous. Mesoscutum and pleura blackish, silvery-cinereous pollinose; four blackish thoracic vittae. Scutellum and abdomen fulvous; the posterior half of abdomen tinged with brownish. Interrupted median vitta of blackish-brown on abdominal segments two or three; faintly visible on anal segment. Legs pale fulvous. Wings and tegulae glassy.

Type.—Cat. No. 22227, U.S.N.M., from East Verde River, Arizona.

Tribe **MUSCINI.**

EUPHORMIA, new genus.

Genotype.—*Musca regina* Meigen.

It has been demonstrated by Villeneuve[1] that *regina* Robineau-Desvoidy (not Meigen), genotype of *Phormia* Robineau-Desvoidy, is *azurea* Fallen. Thus the name *Phormia* takes the place of *Philornis* Meinert (1889), syn. *Protocalliphora* Hough (1899); while *regina* Meigen, which is generically distinct from *azurea* Fallen, will take the name *Euphormia.*

BUFOLUCILIA, new genus.

Genotype.—*Lucilia bufonivora* Moniez, 1876.[2]

Differs from *Lucilia* as follows: Form distinctly narrower. Head not conspicuously flattened in either sex, Epistoma long, wide, strongly warped, but in line with the warp of clypeus. Facial carina not showing between bases of antennae. Facialia not ciliate half way. Third antennal joint two and one-half times second, Arista long-plumose about two-thirds way. Female front equilateral, rather over one-fourth head width; that of male narrowed in front of ocelli to about width of ocellar triangle. Cheeks nearly one-third eye length. Third vein bristled nearly to small crossvein. Apical cell widely open well before tip, the apical crossvein straight. One or two strong erect median marginal pairs on second segment, strong erect marginal row on third, anal segment covered with erect bristles which are shorter in female.

Lucilia silvarum Meigen also belongs in this genus.

The maggots described by Mr. L. G. Guthrie,[3] and determined by Brauer as *Calliphora*, are quite certainly this genus.

Tribe **STEPHANOSTOMATINI.**

CHLOROSARCOPHAGA, new genus.

Genotype.—*Chlorosarcophaga cochliomyia*, new species.

Clypeus considerably sunken but not deep. Epistoma very short, full width, warped. Facialia set with short setae over halfway.

[1] Wien. Ent. Zeit., 1911.

[2] Ent. Month. Mag. vol. 28, p. 10.

[3] Bull. Dep. Nord Lille, vol. 8, p. 25; and also vol. 9, 1878.

Proboscis short, palpi club-shaped, subcompressed. Third antennal joint about three and one-half times second. Arista thinly long-plumose about two-thirds way. Frontals diverging one below base of antennae. Two proclinate fronto-orbitals in female. Ocellars present. Parafacialia irregularly set with several faint hairs down middle. Cheeks over one-fifth eye length. Three sternopleurals and postsuturals; two postintraalars; one preacrostichal and post-acrostichal; three lateral scutellars, but no apical. Third vein bristled halfway to small crossvein; others bare. Apical cell widely open some distance before tip. Hind crossvein nearer to cubitus, which bears a wrinkle. No median marginals on first two segments; marginal row on third and anal segments. First hypopygial tergite of female entire.

CHLOROSARCOPHAGA COCHLIOMYIA, new species.

Length, 6.5 mm. One female, Upper Chagres River, Canal Zone, Panama, October 9, 1917, 548 (Harold Morrison).

Dull metallic green, thinly pollinose. Face, front and occipital orbits golden; frontalia, antennae and palpi black. Mesoscutum brassy-silvery pollinose, leaving three broad dark vittae like those of *Cochliomyia*. Scutellum and abdomen thinly marmorate with silvery. Hypopygium rufous. Legs black, femora greenish. Wings faintly smoky-yellowish. Tegulae glassy-whitish.

Type.—Cat. No. 22086, U.S.N.M.

PETROSARCOPHAGA, new genus.

Genotype.—Petrosarcophaga arizonica, new species.

Clypeus rather elongate, about twice as long as wide. Epistoma elongate, narrow, somewhat warped. Facialia bristled halfway. Proboscis short, palpi club-shaped and bowed. Third antennal joint about three and one-half times second. Arista long-plumose about two-thirds way. Eyes bare. Frontals diverging one or two below base of antennae. No proclinate fronto-orbitals in male. Ocellars present. Parafacialia about as wide as clypeus, set with a few scattered setae; a row of bristly hairs next eye. Cheeks three-fifths eye length. No preacrostichals; one postacrostichal; two postintraalars and lateral scutellars; three sternopleurals; four postsuturals, the two anterior ones short. A moderately short erect decussate apical pair of scutellars in male, none in female. Third vein bristled over halfway to small crossvein, others bare. Apical cell open well before tip. Cubitus two-fifths the wing breadth from hind margin. Posterior crossvein nearer to cubitus. Male tibiae all lacking long hair. No median marginals on first two segments, median marginal pair on third, marginal row on anal segment. First hypopygial tergite of female showing a carinate seam or fold on median line, and excised in a vertical slit set with bristles.

PETROSARCOPHAGA ARIZONICA, new species.

Length, 12 to 13 mm. Numerous specimens of both sexes, Sabino Basin, Santa Catalina Mountains, Arizona, about 4,000 feet, September 18 to 30, 1918, on rock surfaces of canyon beds (C. H. T. Townsend).

Blackish, ashy-white pollinose. Apical portion of anal segment, hypopygium of both sexes and palpi rufous. Head silvery-white, frontalia and antennae blackish. Thoracic pollen whitish. Abdomen tessellate with more ashy pollen. Legs blackish, tibiae more or less brownish. Tegulae white.

Type.—Cat. No. 22087, U.S.N.M.

Tribe TEPHROMYIINI.

TEPHROMYIOPSIS, new genus.

Genotype.—Megerlea rufocaudata Bigot, 1881.[1]

Facial characters practically same as in *Tephromyia*. Epistoma narrowed from clypeus. Arista long plumose. Apical cell short-petiolate. Abdominal macrochaetae marginal.

Tribe MILTOGRAMMINI.

OPSIDIOPSIS, new genus.

Genotype.—Opsidiopsis oblata, new species.

Differs from *Opsidia* as follows: Much narrower in form, subequilateral viewed from above. Front not very prominent; face of female narrower below than front. Frontalia in middle fully three times as wide as one parafrontal. A proclinate-divaricate pair of ocellars only. Parafacialia sparsely setose, little over half as wide below as above. Cheeks of female about one-fifth eye length. Two sternopleurals; three postintraalars and postsuturals; one or two preacrostichals and postacrostichals; a short discal pair of scutellars. Last section of fifth vein over half preceding section. Abdomen oblong; no median marginals on first segment, median marginal pair on second and third, marginal row on anal; the macrochaetae short.

OPSIDIOPSIS OBLATA, new species.

Length, 5.5 mm. One male, Wild Horse Canyon, Animas Mountains, New Mexico, 5,000 feet, July 21, 1917, on tender mesquite foliage (C. H. T. Townsend).

Black. Head silvery, the pollen covering frontalia less thickly. Palpi blackish, slightly rufous basally. Thorax and scutellum thinly silvery; four thoracic vittae. Abdomen shining black, the forward half of last three segments silvery; the silvery fasciae becoming

[1] Ann. Soc. Ent. France, ser. 6, vol. 8, p. 269; Brauer, Sitz. Akad. Wiss., Math. Nat. Cl., vol. 107, pp. 514–15.

bluish, thinner, and indefinite on their posterior borders in varying lights. Wings clear. Tegulae white.

Type.—Cat. No. 22090, U.S.N.M.

Tribe MICROCHAETININI.

HYPENOMYIA, new genus.

Genotype.—*Hypenomyia petiolata*, new species.

Clypeus narrow, a little sunken. Epistoma narrow, elongate, warped gradually forward from clypeal plane. Facialia bare. Two strong decussate pairs of vibrissae, the lower pair stronger and near oral margin. Proboscis about head height; palpi slender. Third antennal joint one and one-half times second. Arista short-plumose. Eyes bare. Frontals stopping at base of antennae. No proclinate fronto-orbitals in male. Ocellars present. Parafacialia wider than clypeus, short-setose. Cheeks one-half eye length. Three to five, normally four sternopleurals; three postintraalars, postsuturals, and postacrostichals; two preacrostichals and lateral scutellars. A long decussate apical scutellar pair. Costal spine extremely long. Third vein bristled only at base, others bare. Cubitus near middle of wing breadth, with long and strong stump, the apical crossvein strongly sinuate. Apical cell petiolate, ending far before tip, petiole as long as small crossvein or longer and about in line with third vein. Hind crossvein not far from middle or considerably nearer to cubitus. Median discals on intermediate segments. Male claws very long.

HYPENOMYIA PETIOLATA, new species.

Length, 8 to 9 mm. Two females, East Verde River, Arizona, 4,200 feet, October 3, 1917 (C. H. T. Townsend); and both sexes, Los Angeles County, California (Coll. Coquillet).

Blackish, thinly cinereous pollinose. Head rather thickly silvery; frontalia, antennae and palpi brown. Thorax showing four more or less distinct dark vittae. Hind borders of last three adbominal segments brown in increasing width posteriorly, the anal segment being half brown. Tegulae watery-white. Wings nearly clear; narrowly brown at base of third vein, and on small, apical and hind crossveins.

Type.—Cat. No. 22210, U.S.N.M.

Tribe MYIOPHASIINI.

MEGAEULOEWIA, new genus.

Genotype.—*Megaeuloewia morinioides*, new species.

Vibrissal axis equal to antennal axis, about five-sixths of head height. Facial profile little over three-fifths of frontal. Clypeus little sunken, bent in middle in profile, the lower part warped forward

at 45°. Epistoma narrowed from clypeus, elongate, and in plane of lower part of clypeus; the oral margin and vibrissal angles prominent in profile. Facialia bare, much bowed. Vibrissae very strongly decussate. Proboscis nearly head height; palpi nearly twice as long as antennae and considerably swollen distally. Third antennal joint one and one-fourth times second. Arista nearly one and one-half times as long as antennae; swollen only at base, pubescent. Eyes thinly hairy. Female vertex one-third head width. Three to four proclinate fronto-orbitals in female. Parafacialia wider than clypeus, setose in three irregular rows. Cheeks nearly two-thirds eye length. Five to six sternopleurals, four strong; three postsuturals; two postintraalars; preacrostichals and postacrostichals present. Third vein bristled only at base; others bare. Apical cell widely open well before tip. Hind crossvein much nearer to cubitus. Middle metatarsi nearly as long as following joints together. No median marginals on first segment, but two pairs on second segment, marginal row on last two segments; median discal pair on third segment.

MEGAEULOEWIA MORINIOIDES, new species.

Length, 8 mm. One female, Rio Vaca, Pecos National Forest, New Mexico, 8,500 feet, August 27, 1916 (C. H. T. Townsend).

Shining jet black. Head very thinly silvery, varying to blackish in changing lights. Frontalia light brown. Face and cheek grooves brownish-rufous; antennae more rufous. Palpi fuscous, paler distally Mesoscutum very faintly pollinose; the vittae obsolete. Abdomen not pollinose. Wings clear, faintly yellowish costobasally. Tegulae nearly white.

Type.—Cat. No. 22218, U.S.N.M.

Tribe MORINIINI.

STEVENIOPSIS, new genus.

Genotype.—Steveniopsis sinuata, new species.

General Moriniine characters. Form very narrow. Head of Paramacronychia, but epistoma rather wide and arista short. Eyes bare. Arista long-pubescent or short-plumose. Parafacialia nearly as wide as clypeus; setose in three rows, the three to five lowest bristles of outermost row strong. Two preacrostichals and lateral scutellars; three postintraalars, postsuturals, and postacrostichals; four or five sternopleurals; rather long divaricate apical scutellar pair. Costal spine very strong. Third vein bristled nearly or quite one-third way to small crossvein, others bare. Apical cell long-petiolate, ending far before tip, the petiole about twice as long as small crossvein. Hind crossvein a little nearer to cubitus, latter half way between the front and hind wing margins. Apical crossvein sinuate. Abdomen cylindroconical. Median marginal pair on first two

segments; median discal pair on intermediate segments; median row on last two, but that on anal weak; two strong discal rows rather irregular on anal.

STEVENIOPSIS SINUATA, new species.

Length, 8 mm. One male, Manzanares Creek, Pecos National Forest, New Mexico, 7,500 feet, August 30, 1916 (C. H. T. Townsend).

Brown to blackish, very thinly cinereous pollinose. Palpi, antennae, and frontalia black. Head black, thinly pollinose, more thickly pollinose on sides of face and front. Thorax rather thinly pollinose, leaving four narrow black vittae, the inner pair merged with blackish area between them. Abdomen submarmorate with cinereous pollen, hind margina of segments broadly brownish pollinose. Wings nearly clear, veins dark brown. Tegulae whitish.

Type.—Cat. No. 22255, U.S.N.M.

OPELOUSIA, new genus.

Genotype.—Opelousia obscura, new species.

Clypeus nearly flush. Epistoma short, not warped. Facialia bare. Proboscis very short; palpi short and rather stout. Third antennal joint about two and one-half times second in male. Arista long-pubescent halfway on upper side only. Eyes bare. Male vertex about one-sixth head width. Frontals stopping at base of antennae. Ocellars present. Parafacialia bare, equilateral. Cheeks over one-fourth eye length. Two sternopleurals, postintraalars, and postacrostichals; three postsuturals; one lateral scutellar; no preacrostichals; short erect decussate apical scutellar pair. Costal spine long, doubled. Third vein with one long bristle and some minute ones at base; others bare. Apical cell narrowly open to nearly closed in tip. Hind crossvein about in middle or nearer to small crossvein. Male claws as long as last tarsal joint. No median marginal on first segment; median marginal pair and incomplete marginal row on second; marginal row on last two segments; discal row on anal.

OPELOUSIA OBSCURA, new species.

Length, 4.5 to 5.5 mm. Three males, Opelousas, Louisiana, May, 1897; one male, Fargo, North Dakota.

Brownish, cinereous pollinose. Palpi fulvous. Frontalia and antennae brownish; base of latter obscurely fulvous. Face, cheeks, and sides of front ashy-silvery; occiput cinereous. Thorax subshining, very thinly pollinose, more thickly on humeri; vittae indistinct; a pair more or less visible before suture. Abdomen more thickly cinereous, subshining, leaving an obscure brown median vitta and brownish hind margins to segments. Femora reddish-brown, tibiae fulvous, tarsi dark. Wings clear. Tegulae glassy-whitish.

Type.—Cat. No. 22249, U.S.N.M., from Opelousas, Louisiana

Tribe MELANOMYINI.

PHASIOPHYTO, new genus.

Genotype.—Phasiophyto fumifera, new species.

General Melanomyine characters. Facialia about half as wide as parafacialia. Arista rather thickly short-plumose. Eyes practically bare. Frontals stopping at base of antennae. Parafacialia wide; inner half bare, outer half thickly set with bristles. Cheeks over one-fourth eye length. One lateral scuttelar; two sternopleurals, postintraalars, preacrostichals, and postacrostichals; three postsuturals; long decussate apical scutellar pair. Third vein bristled only at base, others bare. Apical cell nearly closed in tip. Hind crossvein nearer to small crossvein. No median marginals on first segment, but a pair on second, marginal row on last two segments.

PHASIOPHYTO FUMIFERA, new species.

Length, 5 mm. One male, Rio Charape, Jaen Province, Peru, 4,500 feet, September 13, 1911 (C. H. T. Townsend).

Soft blackish-brown. Frontalia and bare parts of face with testaceous or lighter tinge. No distinct thoracic vittae. Abdomen largely brownish-golden pollinose; the bases of last three segments silvery, widening laterally. Wings fuscous on costa. Tegulae fuscous.

Type.—Cat. No. 22253, U.S.N.M.

Tribe ORMIINI.

ORMIA BREVICORNIS, new species.

Length, 7.5 mm. One female, Texas (Belfrage).

Differs from *punctata* Robineau-Desvoidy as follows: Third antennal joint no longer than second. Front almost equal to eye width. Parafacialia wider. Vibrissae weak and indistinct. Cheek grooves reaching half way up face. Facial plate narrowed on lower half. Cheeks nearly two-fifths eye length.

The first-stage maggot has the cephalic spine-clusters, but the spines are arranged in a longitudinal series; in *punctata* they are arranged in a transverse series.

Type.—Cat. No. 22268, U.S.N.M.

ORMIA DOMINICANA, new species.

Length, 6 mm. Three females, San Francisco Mountains, Santo Domingo, September, 1905 (A. Busck).

Differs from *punctata* Robineau-Desvoidy in the face widening evenly from front, the inner border of eyes thus straight in front view, the parafacialia thus noticeably widening above.

The first-stage maggot has one large talon or spine on each side of head, instead of a cluster.

Type.—Cat. No. 22269, U.S.N.M.

Tribe CALIRRHOINI.

PUNAMYOCERA, new genus.

Genotype.—Punamyocera oroyensis, new species.

Differs from *Paramyocera* as follows: Form rather stout, only a little narrowed. Lower profile of head very long, approximating head height. Vibrissal axis fully five-sixths of head height or more. Epistoma almost as long as clypeus, strongly warped. Palpi long and slender. Parafacialia bare, as wide as long. Cheeks fully four-fifths eye length in female. Three sternopleurals, postintraalars, postsuturals, preacrostichals, and postacrostichals; two lateral scutellars; moderately long decussate apical scutellar pair. No median marginals on first segment; median marginal pair on second; median discal pair on intermediate segments; marginal row on last two segments; discal row on anal.

PUNAMYOCERA OROYENSIS, new species.

Length, 10 mm. One female, Oroya, Peru, 12,000 feet, May 7, 1914 (C. H. T. Townsend).

Brownish, cinereous pollinose. Antennae rufous; arista and over distal half of third joint blackish. Palpi fulvous. Frontalia brown. Cheek grooves reddish-brown. Rest of head thinly silvery, appearing dense in varying light, the occipital area cinereous. Thorax and scutellum tawny-silvery; with three blackish vittae, a dull line each side of middle one. Abdomen ashy pollinose, with heavy rather indefinite dark brown median vitta, the hind corners of first three segments shading darker. Femora and tibiae subrufous, tarsi blackish. Wings nearly clear. Tegulae tawny-whitish.

Type.—Cat. No. 22232, U.S.N.M.

STURMIODEXIA, new genus.

Genotype.—Sturmiodexia rubescens, new species.

General Calirrhoine characters. Facial carina wide, high, separating the antennae. Epistoma long, distinctly narrowed. Haustellum about three-fifths head height. Palpi long and subfiliform. Arista long-plumose to tip. Eyes bare. Ocellars strong. Parafacialia as wide as clypeus, bare. Cheeks over half eye length. One postintraalar; one to three, usually two, postacrostichals; two preacrostichals; three sternopleurals, postsuturals, and lateral scutellars; strong decussate apical scutellar pair. Third vein bristled only at base; others bare. Apical cell widely open quite well before tip. Hind crossvein nearer to cubitus. Male claws very long. No median marginals on first two segments, marginal row on last two, discal row on anal.

STURMIODEXIA RUBESCENS, new species.

Length, 9.5 to 10 mm. Four males, Yahuarmayo, Rio Inambari, Peru, 1,700 feet, February 9, 1910 (C. H. T. Townsend).

Brown to brownish-rufous, cinereous pollinose. Antennae and palpi light brownish-fulvous. Head with yellowish tinge to the pollen. Frontalia brown. Thorax and scutellum brown, silvery pollinose with slight brassy tinge; four black thoracic vittae, inner pair narrower and shorter, outer not interrupted Abdomen brownish-rufous, last three segments changeably pollinose, with tawny tinge to pollen which shows golden to cupreous shades in varying light. Legs brown. Wings smoky costobasally and along veins. Tegulae lightly yellowish-smoky.

Type.—Cat. No. 22233, U.S.N.M.

LEPTODEXIA, new genus.

Genotype.—*Leptodexia gracilis*, new species.

General Calirrhoine characters. Facial carina nearly obsolete. Epistoma short, wide, strongly warped. Proboscis about one and one-half times head height. Palpi slender, hardly as long as third antennal joint, thickened some at tip. Third antennal joint about three times second. Arista thinly long-plumose to tip. Ocellars present, weaker in female. Parafacilia bare. Two sternopleurals and lateral scutellars; three postsuturals; no preacrostichals; one postintraalar; one very weak postacrostichal; weak divergent apical scutellar pair. Wings long, narrow, equilateral. Apical cell open almost in tip. Legs long; tarsi elongate in both sexes: male claws long. Median marginal pair on first segment in male but not in female, on intermediate segments in both sexes and tending to marginal row on third; marginal row on anal.

LEPTODEXIA GRACILIS, new species.

Length, 5 to 6 mm. One male and one female, Huascaray Ridge, Jaen Province, Peru, 7,000 feet, September 21 and 22, 1911 (C. H. T. Townsend).

Brown to blackish, cinereous to pale golden pollinose. Palpi fulvous, more or less fuscous apically. Antennae black. Frontalia soft brown with coppery reflection. Rest of head silvery, with faint golden tinge in places. Thorax and abdomen rather thickly pollinose, with decided golden tinge; leaving three thoracic vittae, the middle one over twice as wide as the outer ones and reaching to tip of scutellum, the outer ones broadly interrupted at suture and sharply pointed behind; four large blackish triangles on abdomen, one on each segment. Wings and tegulae faintly smoky-yellowish.

Type.—Cat No. 22257, U.S.N.M.

HESPERODINERA, new genus.

Genotype.—Hesperodinera cinerea, new species.

Differs from *Dinera* as follows: Not so narrowed in form. Facial carina obliquely lowering and extending to epistoma. Haustellum about two-thirds head height. Palpi nearly twice as long as antennae. Antennae inserted well below eye middle. Female vertex about one-third head width. Female frontalia well over half as wide as one Parafacial. Two proclinate ocellar pairs. Parafacialia a little wider than clypeus, well setose. Cheeks three-fifths eye length. Three postintraalars. Third vein bristled only at base. Apical cell petiolate well before tip, petiole nearly or about as long as small crossvein. No stump at cubitus. Abdomen rather broad ovate. Strong median marginal pair on first two segments, median discal pair on intermediate segments, strong marginal row on third, strong discal and rather strong submarginal rows and weak marginal and anterior rows on anal segment.

HESPERODINERA CINEREA, new species.

Length, 7 mm. One female, Harvey's Ranch, Pecos National Forest, New Mexico, 10,000 feet, August 22, 1916 (C. H. T. Townsend).

Blackish, thickly yellowish-cinereous pollinose. Cheek grooves reddish-brown in oblique view. Frontalia light brown. Antennae soft black, second joint pale on distal edge. Palpi fuscous. Five blackish thoracic vittae, moderately distinct, the inner pair narrow and approximated to the median vitta. A pair of indefinitely subtriangular dark spots showing in oblique view on second and third abdominal segments. Legs blackish. Wings clear. Tegulae yellowish-white.

This species was determined by Coquillett as *Myocera rava* Wulp, but that species has the apical cell open.

Type.—Cat. No. 22215, U.S.N.M.

Tribe THERESIINI.

SCHISTOSTEPHANA, new genus.

Genotype.—Schistostephana aurifrons, new species.

Differs from *Gymnobasis* as follows: Form somewhat more narrowed. Clypeus equilateral, fully twice as long as wide. Epistoma strongly warped, subnasute, at 45 degrees from profile of carina. Two verticals in male, the outer one very short. Male frontalia very wide and deeply arcuate at anterior end. Many proclinate-divergent pairs of ocellars, thickly placed and all same length, ordinarily from 8 to 12 pairs evenly divaricate like hair parted at the crown of the head.

SCHISTOSTEPHANA AURIFRONS, new species.

Length, 12 mm. Two males, Rio Charape, Peru, 4,500 feet, September 15, 1911 (C. H. T. Townsend).

Blackish, cinereous pollinose. Face golden. Front dull silvery. Frontalia deep soft brown. Antennae blackish, first two joints dark rufous. Palpi light rufous. Thorax and scutellum silvery, former with three heavy complete equal black vittae, disk of scutellum black. Abdomen blackish, more than posterior half of anal segment rufous; dark parts thinly to thickly silvery, intensity changing with point of view. Wings clear. Tegulae pale glassy-fuscous.

Type.—Cat. No. 22231, U.S.N.M.

OPSOTHERESIA, new genus.

Genotype.—Opsotheresia obesa, new species.

General Theresiine characters. Strong, high facial carina. Epistoma moderately long, warped some from profile of carina. Facialia bare. Haustellum fully two-thirds head height. Palpi rather long and slender, a little thickened at extreme tip. Third antennal joint little over twice second. Arista short-plumose. Eyes bare. Male vertex less than one-fifth head width, the front narrowing therefrom slightly. Ocellars strong. Parafacialia wider than clypeus, equilateral, bare. Cheeks nearly half eye length. Three postintraalars and lateral scutellars; four sternopleurals and postsuturals; one preacrostichal and postacrostichal; long decussate apical scutellar pair. Third vein bristled only at base, others bare. Apical cell open well before tip. Hind crossvein nearer to cubitus. Male claws long. No median marginals on first two segments, marginal row on last two. Hind tibiae thickly short-ciliate.

OPSOTHERESIA OBESA, new species.

Length, 13 mm. One male, Plummers Island, Maryland, June 15, 1908 (W. L. McAtee).

Blackish or dark brown, more or less shining. Palpi fulvous. Antennae reddish-orange, second joint tinged with brown. Frontalia soft dark brown. Rest of head silvery, the cheek grooves showing brownish-red in direct view. Thorax black, thinly silvery; leaving five black vittae, the outer heavy, the median not so wide, these three extending to base of scutellum; the other vittae are narrow, approximated to the median one, and give out a little behind suture. Scutellum testaceous, the extreme base blackish. Abdomen brown, largely shaded with rufous especially posteriorly, thinly silvery pollinose like the scutellum. Wings clear. Tegulae white.

Type.—Cat. No. 22262, U.S.N.M.

PTERINOPTERNA, new genus.

Genotype.—Pterinopterna ciliata, new species.

Clypeus considerably sunken, not twice as long as wide. Epistoma well warped. Facialia bare. Proboscis short; palpi clubshaped, reaching epistoma. Third antennal joint about twice second. Arista short, thinly long-plumose. Eyes thickly pilose. Frontals stopping at base of antennae. No proclinate fronto-orbitals in male. Ocellars present. Parafacialia wider than clypeus, thickly black-pilose on outer lower part. Cheeks over two-fifths eye length. Two postintraalars, preacrostichals and postacrostichals; three sternopleurals and lateral scutellars; four postsuturals. No apical scutellars. Third vein bristled only at base, others bare. Apical cell open some distance before tip. A very short stump at cubitus. Hind crossvein nearer to cubitus. Hind tibiae quite thickly and evenly ciliate with ordinary bristles; hind metatarsi plumose with fine hairs on each side, a double series of long hairs on outer edge and a single series of shorter hairs on inner edge. No median marginals on first segment, a short appressed pair of median marginals on second, a strong erect pair of median marginals on third, marginal row of erect on anal segment.

PTERINOPTERNA CILIATA, new species.

Length, 10 mm. One male, Huascaray Ridge, Jaen Province, Peru, 7,000 feet, September 22, 1911 (C. H. T. Townsend).

Blackish, abdomen widely rufous on sides. Face, including parafacialia and anterior half or so of cheeks, bronze pollinose; rest of cheeks and occiput gray pollinose. Frontalia and parafrontalia soft brownish-black. Antennae brown, third joint reddish at base. Pleura thinly silvery. Mesoscutum more thickly silvery; with five black vittae, of which the next to outer one on each side is narrow, subconfluent with the median vitta and gives out a little behind suture. The three main vittae are heavy, uninterrupted at suture, and narrowly edged with bronze pollen. Scutellum bronze pollinose in a discal triangle, more silvery laterally. Abdomen rufous; median depression of first segment, median vitta, hind border of third segment and most of anal segment dark brown to blackish; front borders of last three segments narrowly silvery, widening in oblique view on median line; median vitta and anal segment showing bronze to silvery pollen in oblique view. Legs black. Wings clear. Tegulae glassy-infuscate.

Type.—Cat. No. 22228, U.S.N.M.

Tribe TRICHODURINI.

TRICHODUROPSIS GUIANENSIS, new species.

Five females, Bartica, British Guiana (Through C. W. Johnson).

Differs from *recta* Schiner as follows: Abdomen and wings colored as in *Trichodura anceps* Wiedemann. Thorax has the median light

golden vitta split anteriorly into three, the darker vittae and lateral marking being pale brown to brown and extending on scutellum, while the long stripes from humeri to scutellum are dark brown. First abdominal segment with median marginal pair. Size is same.

Type.—Cat. No. 22271, U.S.N.M.

Tribe CORDYLIGASTERINI.

EUTOROCCA, new genus.

Genotype.—Eutorocca fasciata, new species.

Clypeus considerably sunken. Epistoma arcuately cut out, in clypeal plane. Facialia short-ciliate one-third way. Proboscis short, palpi stout and flattened. Eyes bare, descending to vibrissal level. Male front narrower posteriorly than length of second antennal joint. Frontals stopping at base of antennae, continuing posteriorly to ocelli in male. No verticals nor proclinate fronto-orbitals in male. Ocellars very weak; ocellar triangle extremely small, atrophied. Parafacialia narrowed almost to a line below, bare. Cheeks hardly one-twelfth eye length in male. One preacrostichal and postacrostichal; two sternopleurals and postintraalars; three postsuturals and lateral scutellars; no apical scutellars. Third vein bristled about one-third way to small crossvein; others bare. Apical cell narrowly open a little before tip. Hind crossvein fully its length from cubitus. Male claws long. Abdomen about twice as long as thorax and narrower than latter. Median marginal pair on first segment; marginal row on last three segments; median discal pair on first three segments; and discal row on anal.

EUTOROCCA FASCIATA, new species.

Length, 8.5 mm. One male, Peradeniya, Ceylon, August 11, 1913 (A. Rutherford).

Dark brown, thinly pollinose. Frontalia, antennae (third joint missing) and palpi brown, the palpi slightly tinged with fulvous. Face and front silvery, shading to pale golden on latter in oblique view. Mesoscutum and scutellum dark metallic-green, faintly silvery in oblique view, more so in front of suture, with four black vittae; humeri and pleura more thickly silvery, latter with two shining brown spots. Abdomen shining dark brown, base of intermediate segments widely golden pollinose, basal half of anal segment silvery pollinose. Wings faintly smoky-yellowish. Tegulae yellowish glassy.

Type.—Cat. No. 22241, U.S.N.M.

Tribe MINTHOINI.

MICROMINTHO, new genus.

Genotype.—Micromintho melania, new species.

Clypeus a little depressed. Epistoma short, gently warped. Facialia bare. Proboscis short, palpi slender. Third antennal joint

about four times second. Arista nearly bare; basal joints short. Eyes bare. Frontals two below base of antennae. Two proclinate fronto-orbitals in male, the hind one short. Ocellars weak. Parafacialia very narrow, with row of four to five facio-orbitals. Cheeks little over one-fourth eye length. One or two short geno-orbitals. One preacrostichal and postacrostichal; two postintraalars and lateral scutellars; three sternopleurals and postsuturals. A long decussate apical pair of scutellars. Costal spine strong. First vein bristled halfway and again in middle of distal half; third bristled to small crossvein; others bare. Apical cell long-petiolate, ending little before tip; petiole as long as posterior crossvein; latter nearer to small crossvein. Last section of fifth vein rather over half of preceding section. No median marginals on first segment, median marginal pair on second; marginal row on third and anal segments. Male claws minute; the front tarsi distinctly swollen and compressed. Abdomen conical.

MICROMINTHO MELANIA, new species.

Length, 3.75 mm. One male, Globe Hills, Arizona, 3,300 feet, on foliage of *Thurberia*, September 10, 1917 (C. H. T. Townsend).

Shining black. Head silvery; face and cheeks more thickly so. Antennae, arista, and frontalia brown. Palpi fulvous. Parafrontalia, thorax and scutellum thinly silvery. Four black thoracic vittae. Narrow front borders of last three abdominal segments silvery-white. Wings clear. Tegulae watery-white.

Type.—Cat. No. 22089, U.S.N.M.

METALLICOMINTHO, new genus.

Genotype.—*Metallicomintho abdominalis*, new species.

Differs from *Micromintho* as follows: Vibrissal axis only a little less than antennal axis and about half head height. Third antennal joint narrower than second and about four times latter. Arista pubescent. Eyes indistinctly short-hairy. Female vertex not one-third head width. Female frontalia not as wide as one parafrontal. Parafacialia considerably narrowed below, with four strong facio-orbitals down middle. Cheeks nearly one-third eye length. First vein bare on distal half. Middle metatarsi as long as following joints together. Female front tarsi plump, compressed, the claws minute. A row of strong erect discals on anal segment. Apical crossvein more oblique, nearly parallel with hind margin of wing. Abdomen depressed.

METALLICOMINTHO ABDOMINALIS, new species.

Length, 6 mm. One female, Castle Butte, Arizona, 5,200 feet, September 19, 1917 (C. H. T. Townsend).

Shining olive-black. Head thinly silvery; the parafrontalia mostly black, only the outer portions silvery. Frontalia soft dark brown.

Second antennal joint, narrow base of third and palpi rufo-fulvous. Thorax very faintly silvery above, much more so on pleura; three heavy silver-white vittae before suture. Scutellum and abdomen with strong olive shade and without pollen; the scutellum rather greenish and the abdomen rather tinged with cupreous or metallic bronze. Legs black, coxae silvery. Wings clear, yellowish along costa. Tegulae yellowish-white, somewhat glassy.

Type.—Cat. No. 22216, U.S.N.M.

Tribe ZELIINI.

PARAZELIA, new genus.

Genotype.—Parazelia pulchra, new species.

Clypeus considerably sunken, subequilateral, nearly three times as long as wide. Epistoma narrow, cut off short, warped. Facialia bare. Proboscis short; palpi long, stout, bowed. Third antennal joint about four times second; constricted basally and bulged on upper side distally. Arista long; moderately long-plumose. Eyes bare. Frontals stopping at base of antennae. No proclinate fronto-orbitals in male. Ocellars present. Parafacialia hardly as wide as the narrow clypeus, microsetose on inner half. Cheeks about two-fifths eye length. Three sternopleurals, postsuturals and lateral scutellars; two postentraalars, preacrostichals; one postacrostichal; no apical scutellars. Third vein bristled only at base, others bare. Apical cell widely open a little before tip. No median marginals on first segment, median marginal pair on second, marginal row on third and anal segments.

PARAZELIA PULCHRA, new species.

Length, 7.5 mm. One male, Trinidad Rio, Panama, March 23, 1912 (A. Busck).

Brown to blackish. Cheek grooves light brown; frontalia dark brown. Palpi brown, tips pale. Antennae dark brown, shading lighter distally. Rest of head ashy pollinose with a brassy tinge. Mesoscutum thinly silvery to pale brassy pollinose, with four blackish vittae, the outer ones heavy. Scutellum blackish basally; pale brassy pollinose on distal half or so. Abdomen pale brassy pollinose on front half or more of last three segments, the pollinose bands increasing in width posteriorly and widening laterally, a median vitta of brown showing indistinctly. Legs brown. Wings faintly smoky, distinctly so on costa. Tegulae glassy, tinged with smoky-yellowish.

Type.—Cat. No. 22206, U.S.N.M.

MINTHOZELIA, new genus.

Genotype.—Minthozelia montana, new species.

Epistoma short, slightly warped. Facialia bare. Proboscis short; palpi slender, a little thickened at tip. Third antennal joint one and one-half times second. Arista long-plumose. Eyes bare. Frontals

stopping at base of antennae. Ocellars absent. Parafacialia bare, nearly as wide as clypeus. Cheeks less than one-third eye length, Three sternopleurals, postintraalars, postsuturals, preacrostichals, postacrostichals and lateral scutellars; no apical scutellars. Third vein bristled only at base; others bare. Apical cell narrowly open a little before tip. Hind crossvein nearer to cubitus. Median marginal pair on first two segments; marginal row on third and anal segments.

MINTHOZELIA MONTANA, new species.

Length, 5.5 mm. One female, Sixshooter Canyon, Pinal Mountains, Arizona, 5,000 feet., September 2, 1917 (C. H. T. Townsend).

Black, silvery-white pollinose. Frontalia soft brown. Antennae fulvous, tinged with fuscous. Palpi fulvous. Four indefinite changeable thoracic vittae. Anterior border of last three abdominal segments silvery-white, the rest shining black. Wings clear. Tegulae-glassy-white.

Type.—Cat. No. 22204, U.S.N.M.

OPSOZELIA, new genus.

Genotype.—Opsozelia discalis, new species

Zeliine characters in general. Clypeus slightly sunken; epistoma long and strongly warped. Haustellum fully half head height, corneous; palpi stout, nearly as long as antennae. Third antennal joint about four times second. Arista thickly long-plumose to tip, with two rows of cilia above. Eyes bare. Frontals thickly placed in male. Two strong ocellar pairs. Parafacialia hardly over half as wide as clypeus, equilateral, bare. Cheeks hardly one-third eye length. One postintraalar; two preacrostichals and postacrostichals; three sternopleurals, postsuturals and lateral scutellars; no apical scutellars. Third vein bristled about one-third way to small crossvein; others bare. Apical cell widely open well before tip. Cubitus near margin, with faint wrinkle. Hind crossvein nearer to cubitus. Male tarsi and claws long and stout. No median marginals on first segment, but a pair on second; three median discal pairs in file on each of intermediate segments; marginal row on last two segments; anal segment with submarginal and discal rows also. Fifth sternite of male large.

OPSOZELIA DISCALIS, new species.

Length, 13 mm. One male, Bartica, British Guiana, July 10, 1901 (through C. W. Johnson).

Brown to blackish; abdomen largely yellow. Antennae clear deep fulvous; the palpi nearly the same shade. Frontalia soft dark brown, shining in oblique view. Rest of head thickly ashy-silvery pollinose. Thorax and scutellum thickly ashy-silvery; with four

blackish vittae, the inner pair shorter. Abdomen pale yellow, heavy median vitta blackish; anal segment and irregular posterior half of third rufous; hind border of second pale smoky-rufous; anal segment thinly silvery pollinose, showing more densely on base and sides. Femora and tibiae tinged with rufous. Wings tinged with smoky-yellowish on costal half or so. Tegulae glassy.

Type.—Cat. No. 22237, U.S.N.M.

Tribe EUTHELAIRINI.

PARATHELAIRA, new genus.

Genotype.—Parathelaira panamensis, new species.

Clypeus well sunken. Epistoma rather short, abruptly warped. Facialia bare. Proboscis very short; palpi long and slender. Third antennal joint two and one-half times second in male. Arista much longer than antennae, thin, bare. Eyes bare. Male vertex about one-seventh head width. One frontal below base of antennae. No proclinate fronto-orbitals in male. Ocellars very weak. Parafacialia narrow, bare. Cheeks little over one-sixth eye length. Two sternopleurals; three postintraalars, postsuturals, preacrostichals, postacrostichals, and lateral scutellars; no apical scutellars. Costal spine present. Third vein bristled only at base; others bare. Apical cell open a little before tip. Hind crossvein a little nearer cubitus. Male claws long. Median marginal pair on first two segments; median discal pair on intermediate segments, marginal row on last two segments; submarginal and two discal rows on anal segment.

PARATHELAIRA PANAMENSIS, new species.

Length, 9.5 mm. One male, Porto Bello, Panama, February 25, 1911 (A. Busck).

Brownish, silvery pollinose. Palpi, basal half of antennae, parafacialia, anterior half of parafrontalia, and base of last three abdominal segments pale fulvous; these parts all silvery pollinose except palpi and antennae. Four dark thoracic vittae, the inner pair a little narrower. Wings faintly and evenly smoky-yellow. Tegulae glassy-whitish.

Type.—Cat. No. 22224, U.S.N.M.

LYDELLOTHELAIRA, new genus.

Genotype.—Lydellothelaira collaris, new species.

Clypeus rather deeply sunken. Epistoma short; nearly in clypeal plane. Facialia strongly ciliate over halfway. Proboscis very short; palpi heavy, wide, short, bowed. Third antennal joint about three and one-half times second in male. Eyes bare. Male front well over one-fourth head width. Two frontals below base of antennae, but in straignt line. Two proclinate fronto-orbitals in male. Ocellars

present. Parafacialia narrow, bare. Cheeks about one-fourth eye length. Two sternopleurals and preacrostichals; three postintraalars, postsuturals, postacrostichals, and lateral scutellars; a weak apical scutellar pair. Third vein bristled only at base; others bare. Apical cell widely open a little before tip. Hind crossvein a little nearer to cubitus. Male claws short. All four abdominal segments with marginal row.

LYDELLOTHELAIRA COLLARIS, new species.

Length, 7.5 mm.; of wing, 8 mm. One male, Casahuiri, Peru, 4,500 feet, February 4, 1910 (C. H. T. Townsend).

Brown to blackish. Parafacialia and most of parafrontalia pale yellowish pollinose; clypeus and facialia thinly silvery. Antennae blackish; first two joints brown. Frontalia light brown. Palpi brown. Thorax and scutellum soft dark brown; mesoscutal suture bordered in front by a narrow irregular silvery fascia confluent with silvery of humeri, and extending obliquely and broadly down on pleura. Abdomen subshining brown; last three segments with narrow anterior border of silvery to pale brassy pollen. Wings nearly clear. Tegulae whitish, narrowly edged with yellow.

Type.—Cat. No. 22219, U.S.N.M.

THELAIROCHAETONA, new genus.

Genotype.—Thelairochaetona thrix, new species.

Clypeus moderately sunken. Epistoma cut off; faintly warped. Facialia bare. Proboscis very short; palpi stout and bowed. Third antennal joint about four times second. Arista longer than antennae, thin, finely pubescent one-fourth way. Eyes bare. Female vertex one-fourth head width. Two frontals below base of antennae. Two strong proclinate fronto-orbitals in female. Ocellars present. Parafacialia narrow, bare. Cheeks hardly one-fifth eye length. Three sternopleurals, postintraalars, postsuturals, preacrostichals and lateral scutellars; two postacrostichals; short apical pair of scutellars. Costal spine present. First vein bristled nearly halfway; third bristled to small crossvein; others bare (one bristlet on fifth vein in one wing). Apical cell widely open considerably before tip. Hind crossvein nearer to cubitus. Median marginal pair on first two segments; median discal pair on second and third; marginal row on last two; and discal row on anal segment.

THELAIROCHAETOMA THRIX, new species.

Length, 9 mm. One female, Porto Bello, Panama, April 18, 1912 (A. Busck).

Blackish, cinereous pollinose. Palpi rufous. Pollen of parafrontalia with strong golden tinge. Antennae blackish. Frontalia soft

brown. Thorax and scutellum brassy-cinereous; leaving four black vittae, the outer ones interrupted. Basal half of last three abdominal segments thickly brassy-cinereous pollinose; the rest of abdomen shining brown. Legs dark brown to blackish. Wings lightly yellowish-smoky, especially on costa. Tegulae yellowish-white.

Type.—Cat. No. 22220, U.S.N.M.

Tribe URAMYINI.

ANAPORIA, new genus.

Genotype.—*Aporia limacodis* Townsend, 1892.[1]

Differs from *Paraporia* mainly in the clypeus being distinctly, though slightly sunken, the arista thickly short-pubescent halfway, the male abdomen conico-subcylindrical and truncate anally. The clypeus is quite flush in *Paraporia*, while the male abdomen is flattened and pointed anally. The ocellars are quite strong, at least in male, and there are two weak discal scutellar pairs. There are no well-developed median anterior macrochaetae on second segment.

PSEUDEUANTHA OCTOMACULATA, new species.

Length, 13 mm. One male, Huadquina, Peru, 5,000 feet, July 30, 1911 (Yale Peruvian Expedition).

Differs in coloration from *Paraporia quadrimaculata* as follows: All four of the abdominal segments with whitish lateral spots which are small and restricted. Wings conspicuously yellow across basal third; brown on outer two-thirds of costal portion. The grayish pollen has a yellowish or brassy tinge.

Type.—Cat. No. 22272, U.S.N.M.

MICROAPORIA, new genus.

Genotype.—*Microaporia elegans*, new species.

Near *Chaetonopsis*, with main characters as follows: Form very narrow. Arista long-pubescent, mostly on upper side. Eyes bare, pushed far forward below. Male front prominent, vertex nearly one-fourth head width. Ocellars very weak. Frontals stopping at base of antennae. Frontalia very wide. Parafacialia bare. Cheeks nearly one-third eye length. No postacrostichals; one preacrostichal and lateral scutellar; two sternopleurals and postintraalars; three postsuturals; medium decussate apical scutellar pair. Costal spine strong. Third vein with one strong bristle at base; others bare. Apical cell open a little before tip. Hind crossvein near middle. Male claws long. Abdomen narrow and elongate; widest on hind margin of first segment, gradually narrowing posteriorly. Median marginal pair on first segment, marginal row on last three segments; median discal pair on intermediate segments; discal row on anal.

[1] Psyche, vol. 6, p. 275.

MICROAPORIA ELEGANS, new species.

Length, 4.5 mm. One male, Cuzco, Peru, February 21, 1910 (C. H. T. Townsend).

Dark brown or blackish, rather thinly silvery. Antennae and palpi black. Frontalia and cheek grooves soft blackish-brown. Rest of head thinly silvery, with blackish reflections in varying light. Thorax and scutellum thinly silvery; two very broad black vittae on thorax, reaching on sides of scutellum; similar wide vitta on pleura from wing root to lower humeral region, also extending back to halters. Abdomen subshining dark brown, basal half of last three segments thinly silvery pollinose, changing to brassy in varying light. Legs brown. Wings clear. Tegulae whitish, somewhat fuscous on inner edge.

Type.—Cat. No. 22238, U.S.N.M.

Tribe LESKIINI.

TROCHILOGLOSSA, new genus.

Genotype.—Trochiloglossa tropica, new species.

Clypeus flush. Epistoma wide, strongly warped, nearly half as long as clypeus. Facialia bare. Haustellum about two and one-half times head height, nearly long enough to reach tip of abdomen; curved backward; palpi long, subcylindrical. Third antennal joint about one and one-half times second. Arista bare; basal joints short. Eyes bare. Frontals diverging one bristle at base of antennae. Two proclinate fronto-orbitals of female crowded nearly into frontal row. Ocellars present. Parafacialia narrow, bare. Cheeks not over one-fifth eye length. One postacrostichal; two postintraalars, preacrostichals and lateral scutellars; three sternopleurals and postsuturals. A weak divergent apical scutellar pair. Third vein bristled only at base, others bare. Apical cell narrow, open a little before tip. Posterior crossvein nearer to cubitus. No median marginals on first segment; median marginal pair on second; marginal row on third and anal segments.

TROCHILOGLOSSA TROPICA, new species.

Length, 8 mm. One female, Chapada, Brazil (H. H. Smith).

Tawny flavous. Head and thorax silvery pollinose; scutellum and abdomen less thickly so. Pleura and posterior half of abdomen darker in ground color, cinereous pollinose. Frontalia, antennae, palpi and legs yellowish; the tarsi darker. Wings clear, with yellowish along the veins. Tegulae watery-white.

Type.—In American Museum of Natural History.

BESKIOLESKIA, new genus.

Genotype.—Beskioleskia busckii, new species.

Clypeus flush, long, narrow, bent in middle, the lower half warped forward. Epistoma short, full width. Facialia bare. Vibrissae distinct from the other bristles. Haustellum not as long as head height; palpi fully as long as antennae, bent in middle, distal half compressed and gently widened. Third antennal joint about five times second. Arista long-pubescent. Eyes bare. Frontals stopping at base of antennae. Two very short and weak proclinate fronto-orbitals in female. No ocellars, ocellar triangle atrophied, ocelli very small. Parafacialia bare. Cheeks not over one-fourth eye length. Two sternopleurals and postintraalars; three postsuturals, preacrostichals, postacrostichals and lateral scutellars; no apical scutellars. Third vein bristled to small crossvein; others bare. Apical cell open nearly in tip. Hind crossvein nearer to cubitus but distant. No median marginals on first two segments; marginal row on third and anal; and median discal pair on anal.

BESKIOLESKIA BUSCKII, new species.

Length, 5 to 6.25 mm. Two females, Cabima and Taboga Islands, Panama, May 23 and June 19, 1911 (A. Busck).

Pale luteous to pale fulvous. Third antennal joint smoky-rufous. Frontalia light golden. Mesoscutum bright golden pollinose, with four faint narrow smoky-yellow vittae. Abdomen subrufous on posterior half or so, including median vitta and posterior part of second segment; second and third segments with brown spot at posterior margin on median line. Tarsi appearing dark from the vestiture. Wings slightly smoky-yellowish; more yellowish on costa. Tegulae yellowish.

Type.—Cat. No. 22207, U.S.N.M.

Tribe MYIOMINTHOINI.

UROCHAETONA, new genus.

Genotype.—Urochaetona longipes, new species.

Differs from *Phyllophilopsis* as follows: Palpi not swollen in either sex. Arista moderately long-plumose to tip. Two sternopleurals and postintraalars; postacrostichals only hair like; preacrostichals short. Hind legs very elongate in male, especially the tarsi. Abdomen more elongate and more pointed behind. Strong erect median marginal pair on first abdominal segment.

UROCHAETONA LONGIPES, new species.

Length, 4.5 to 5.5 mm. One male and one female, Yahuarmayo, Rio Inambari, Peru, 1,700 feet, February 9 and 11, 1910, on foliage (C. H. T. Townsend).

Shining dark brown. Frontalia with fulvo-cupreous reflection in oblique view. Face, third antennal joint and sides of front silvery. Palpi fuscous. Thorax silvery; with three wide black vittae; the middle one more or less fulvous pollinose on median line before suture especially in male; the outer ones interrupted by a narrow silvery pollinose border on hind edge of prescutum. Scutellum and abdomen without pollen except the narrow thinly silvery bases of last three segments. Wings and tegulae moderately yellowish-fuscous; paler in female.

Type.—Cat. No. 22230, U.S.N.M.

URODEXIA SIAMENSIS, new species.

Length, 13 mm. to end of tail; tail, 5 mm. One male, Khow Sai Dow, 1,000 feet, Trong, Lower Siam, January to February, 1899 (W. L. Abbott).

Head silvery, shading to golden on sides of front. Palpi fuscous. Antennae black; third joint grayish. Frontalia dark brown. Pleura silvery; mesoscutum golden, with four narrow dark brown vittae; the outer ones widely interrupted at suture and abbreviated anteriorly, while behind suture they are connected by a broad dark brown fascia covering a little more than the anterior half of the postscutum. Scutellum dark brown except the golden tip, as though crossed by a similar dark fascia. Abdomen brown; the bases of intermediate segments broadly golden pollinose; anal segment silvery with the tail brown. Legs light brown. Wings and tegulae lightly smoky-yellow.

Type.—Cat. No. 22267, U.S.N.M.

PSEUDOCHAETONA, new genus.

Genotype.—Pseudochaetona polita, new species.

Head characters of *Pseudodexia.* Third antennal joint four or five times second. Arista longer than antennae, slender, thinly short-plumose to tip. Eyes bare. Frontals one or two weak below base of antennae. One vertical in male. Ocellars vestigial. Parafacialia very narrow, bare. Cheeks hardly one-eighth eye length. One preacrostichal, postacrostichal and lateral scutellar; two sternopleurals and postintraalars; three postsuturals; long decussate apical scutellar pair. Third vein bristled only at base; others bare. Apical cell open just before tip. Hind crossvein nearly in middle. Apical crossvein deeply bowed in. No median marginals on first segment, but a pair on second; marginal row on last two segments.

PSEUDOCHAETONA POLITA, new species.

Length, 6.5 mm. One female, Trinidad Rio, Panama, March 25, 1912 (A. Busck); one male, Yahuarmayo, Peru, February 10, 1910 (C. H. T. Townsend).

Palpi pale straw-color. Antennae pale fulvous; third joint in female largely fuscous. Frontalia brownish. Rest of head silvery, pale golden on parafrontalia. Pleura brown, with a broad oblique silvery fascia. Mesoscutum pale golden pollinose, the irregular forward half of postscutum shining dark brown. Scutellum shining brown, the tip golden pollinose. Abdomen shining dark brown or blackish; the base yellow as far as middle of second segment, but leaving a dark median vitta in male; base of third segment narrowly yellow on sides; bases of last three segments silvery to pale golden pollinose. Femora yellow; the tips and rest of legs darker. Wings nearly clear, faintly smoky-yellowish. Tegulae glassy, slightly tawny.

Type.—Cat. No. 22251, U.S.N.M., from Panama.

MINTHOMYIA, new genus.

Genotype.—*Minthomyia abdominalis*, new species.

Clypeus very shallow. Epistoma short, not warped. Facialia bare. Proboscis very short; palpi short and wide. Third antennal joint about three times second in male, widening somewhat apically. Arista a little longer than antennae, bare. Eyes bare. Male vertex about one-seventh head width. Two frontals below base of antennae. No proclinate fronto-orbitals in male. Parafacialia extremely narrow, bare. Cheeks hardly one-sixth eye length in male. One preacrostichal; two sternopleurals and postsuturals; three postintraalars and lateral scutellars; no apical scutellars. Third vein bristled only at base; others bare. Apical cell open just before tip. Hind crossvein a little nearer to cubitus. Male tarsi and claws long. Median marginal pair on first two segments; marginal row on last two.

MINTHIOMYIA ABDOMINALIS, new species.

Length, 6.5 mm. One male, Rio Charape, Jaen Province, Peru, 4,500 feet, September 12, 1911 (C. H. T. Townsend).

Blackish, abdomen yellowish. Head thinly silvery. Palpi fulvous. Articulation of antennae and base of arista tinged with fulvous. Frontalia and posterior half of parafrontalia brown. Disk of mesoscutum, humeri, and pleura thinly ashy, leaving two broad shining vittae and scutellum bare. Abdomen fulvous-yellow; the anal segment and posterior border of third brownish from the dried contents of abdomen. Wings lightly smoky, more deeply so on outer half of costa. Tegulae glassy-yellowish.

Type.—Cat. No. 22235, U.S.N.M.

TELOTHYRIOSOMA, new genus.

Genotype.—*Telothyriosma tersa*, new species.

Clypeus a little sunken. Epistoma cut off, warped on edge. Facialia ciliate one-fourth way. Proboscis short, palpi rather club-shaped. Third antennal joint hardly three times second in male.

Arista faintly pubescent one-third way. Eyes thinly short-haired. Male vertex about one-seventh head width. Two frontals below base of antennae. No proclinate fronto-orbitals in male. No ocellars. Parafacialia very narrow, bare. Cheeks about one-eighth eye length. Two sternopleurals and postsuturals; three postintraalars, preacrostichals, postacrostichals, and lateral scutellars; very weak apical scutellar pair. Costal spine strong. Third vein bristled only at base; others bare. Apical cell narrowly open just before tip. Hind crossvein nearer to cubitus. Male hind tibiae strongly bowed, claws long. Median marginal pair on first two segments and marginal row on last two.

TELOTHYRIOSOMA TERSA, new species.

Length, 7.5 mm. One male, Cayuga, Guatemala, April, 1915 (William Schaus).

Palpi fulvous. Antennae wholly clear pale fulvo-rufous, including base of arista. Face thinly silvery; front brassy. Thorax and scutellum brassy with four dark vittae; inner pair narrow and linear. First two abdominal segments clear light yellow; narrow median vitta and last two segments, including posterior edge of second, largely due to dried contents of abdomen, brown; third segment thinly brassy, showing most on front edge; anal segment thickly brassy. Legs brown. Wings and tegulae moderately smoky.

Type.—Cat. No. 22234, U.S.N.M.

MICROCHAETONA, new genus.

Genotype.—*Michrochaetona gracilis,* new species.

Differs from *Phyllophilopsis* as follows: Very slender. Only two sternopleurals and postintraalars. One strong vertical in male. Male abdomen not very much longer than thorax, in shape like the female of *Phyllophilopsis.* Male wings only about twice as long as thorax.

MICROCHAETONA GRACILIS, new species.

Length, 3 to 3.5 mm. Two males, Yahuarmayo, Rio Inambari, Peru, 1,700 feet, February 12, 1910, on foliage (C. H. T. Townsend).

Dark brown to blackish. Frontalia with golden reflection in oblique view. Palpi pale yellowish to fuscous. Antennae blackish. Rest of head silvery. Thorax, scutellum, and abdomen shining brown; humeri and median vitta in front of suture silvery. Pleura faintly silvery. Legs pale brown, tarsi darker. Wings light smoky-yellow, pale on inner border and axilla. Tegulae glassy-fuscous.

Type.—Cat. No. 22236, U.S.N.M.

OPSOLESKIA, new genus.

Genotype.—*Opsoleskia flava,* new species.

Clypeus appreciably sunken. Epistoma wide, short, faintly warped. Facialia bare. Proboscis little over half head height; palpi

short and rather slender. Third antennal joint about three times second in male; rather narrow. Arista moderately long-pubescent halfway. Eyes bare. Male vertex hardly one-seventh head width. One frontal below base of antennae. No proclinate fronto-orbitals in male. No ocellars. Parafacialia very narrow, bare. Cheeks scarcely one-sixth eye length. Two sternopleurals, postsuturals, and postacrostichals; three postintraalars, preacrostichals, and lateral scutellars; no apical scutellars. Third vein bristled only at base, others bare. Apical cell open just before tip. Hind crossvein a little nearer to cubitus. Tarsi and claws long in male. Median marginal pair on first two segments, marginal row on last two.

OPSOLESKIA FLAVA, new species.

Length, 7 mm. One male, Bartica, British Guiana, June 4, 1901 (through C. W. Johnson).

Fulvous-yellow. Frontalia brown. Third antennal joint and arista tinged with fuscous. Palpi pale yellow. Rest of head silvery, shading to golden on front. Thorax rather thickly pale golden pollinose; four dark vittae, the inner pair narrow, the outer ones widely interrupted. Abdomen wholly light yellowish, appearing bare in direct view but showing thin pollen coat in oblique view. Legs fulvous. Wings slightly tinged with fuscous, more so on outer half. Tegulae glassy-yellowish.

Type.—Cat. No. 22240, U.S.N.M.

Tribe VORIINI.

OESTROPLAGIA, new genus.

Genotype.—Oestroplagia petiolata, new species.

Clypeus only slightly depressed. Epistoma short, slightly warped. Facialia ciliate about or nearly halfway above vibrissae. Proboscis short; palpi club-shaped. Second antennal joint elongate; the third no longer than second. Arista short, bare, basal joints short. Eyes bare, the inner border sinuate in male. Frontals in three rows in male, descending four bristles below base of antennae. No proclinate fronto-orbitals in male. Ocellars present. Parafacialia bare. Cheecks one-fourth eye length. Several geno-orbitals. Four sternopleurals, postsuturals, and lateral scutellars; three postintraalars, preacrostichals, and postacrostichals. A weak suberect nondecussate apical pair of scutellars. Costal spine strong. Third vein bristled only at base; others bare. Apical cell petiolate far before tip; the petiole nearly twice as long as small crossvein. Cubitus nearly in middle of wing breadth, with strong stump. Posterior crossvein nearly its length from cubitus. No median marginals on first segment; median marginal pair on second; marginal row on third; discal row on anal with marginal and submarginal bristles.

OESTROPLAGIA PETIOLATA, new species.

Length, 6 mm. One male, Sabino Basin, Santa Catalina Mountains, Arizona, 3,550 feet, October 12, 1918, on flowers of *Baccharis sarothroides* Gray (C. H. T. Townsend).

Black. Head very faintly grayish, frontalia brown; second antennal joint and base of third rufous; palpi fulvous. Body lead-gray pollinose; four black equal thoracic vittae; first abdominal segments, subobsolete median line, and irregular hind borders of last three segments black; nearly the posterior half of anal segment blackish. The black of intermediate segments changes with varying light, running forward on sides in oblique view. Legs black. Tegulae white. Wings clear; the veins black.

Type.—Cat. No. 22088, U.S.N.M.

VIBRISSOVORIA, new genus.

Genotype.—Vibrissovoria petiolata, new species.

Clypeus long, considerably sunken. Epistoma narrow, rather long, strongly warped. Facialia ciliate over halfway. Proboscis short; palpi long, stout, bowed. Second antennal joint long; third hardly twice second. Arista bare, short, thickened nearly to the sharp tip; second joint over half third. Eyes bare. Male frontals in two rows, three bristles below base of antennae. No proclinate fronto-orbitals in male. Ocellars present, perhaps reclinate (injured). Parafacialia wide, bare. Cheeks one-fourth eye length. Three sternopleurals, postintraalars, preacrostichals, postacrostichals, and lateral scutellars; four postsuturals. A very weak divaricate apical scutellar pair. Costal spine moderately long. Third vein bristled only at base; others bare. Apical cell petiolate, ending well before tip; petiole as long as small crossvein. Posterior crossvein in middle. Last section of fifth vein over one-third preceding. No median marginals on first segment; median marginal pair on second; marginal row on third and anal segments.

VIBRISSOVORIA PETIOLATA, new species.

Length, 8 mm. One male, Balboa Prado, Canal Zone, Panama, July 2, 1918, G 32d (H. F. Dietz).

Blackish, gray pollinose. Face and front silvery. Thorax silvery, leaving four equal black vittae, the two of each side convergent behind suture. Scutellum thinly silvery; more so on tip. Abdominal segments thinly silvery, except hind margins and median line. Anal segment mostly reddish; sides of second segment faintly reddish. Wings clear. Tegulae white.

Type.—Cat. No. 22085, U.S.N.M.

Tribe MACQUARTIINI.

MATUCANIA, new genus.

Genotype.—*Matucania mellisquama*, new species.

Clypeus gently sunken. Epistoma very short, not warped. Facialia ciliate less than one-third way. Proboscis very short; palpi stout, long, bowed. Third antennal joint about three times second in male. Arista longer than antennae, thin, bare. Eyes thickly very long-pilose. Male vertex not one-fourth head width. Frontals stopping near base of antennae. Ocellars present. Parafacialia bare. Cheeks about two-fifths eye length. Two preacrostichals and lateral scutellars; three sternopleurals, postintraalars, and postsuturals; two or three postacrostichals; rather long slender strongly decussate apical scutellar pair. Third vein bristled only at base; others bare. Apical cell open considerably before tip. Hind crossvein nearer to cubitus. Male claws long; median marginal pair on first two segments; median discal pair on intermediate segments; marginal row on last two segments; discal row on anal.

MATUCANIA MELLISQUAMA, new species.

Length, 7.5 to 8 mm. Two males, Matucana, Peru, 8,000 feet, January 30, 1913, and May 1, 1914 (C. H. T. Townsend).

Black, rather shining, with faint metallic bluish reflection, thinly silvery. Antennae black. Fontalia brown. Palpi fulvous. Rest of head silvery. Pollen thicker on front and lateral edges of thorax, and on pleura; four black vittae, the inner narrow, the outer blotchlike and ill-defined. Abdomen silvery on bases of segments laterally, the disks of first three segments showing triangular areas of rusty pollen in oblique view. Hind tibiae rather rufous or fulvous, the others less so. Wings faintly smoky-yellowish, more so costally. Tegulae honey-colored.

Type.—Cat. No. 22250, U.S.N.M.

LEPTOMACQUARTIA, new genus.

Genotype.—*Leptomacquartia planifrons*, new species.

Clypeus flush. Epistoma very short, little warped. Facialia finely ciliate about halfway. Proboscis about two-thirds head height; palpi long, slender, crooked. Third antennal joint about twice second in male. Arista microscopically pubescent basally. Eyes nearly bare. Front of male much flattened, vertex not over one-tenth head width. One frontal below base of antennae. Ocellars present. Two sternopleurals, postintraalars and lateral scutellars; three postsuturals; one or two preacrostichals; postacrostichals at most very weak; short decussate apical scutellar pair. Third vein bristled only at base; others bare. Apical cell open a little

before tip. Hind crossvein nearer to cubitus. Male tarsi and claws long; median marginal pair on first segment, median marginal pair or marginal row on second; median discal pair on second; marginal row on last two segments; median discal pair or discal row on third; discal row on anal.

LEPTOMACQUARTIA PLANIFRONS, new species.

Length, 6.5 to 7 mm. Three males, Matucana, Peru, 8,000 feet, January 30 and August 16, 1913, on foliage (C. H. T. Townsend).

Head black, thinly silvery on face and sides of front. Antennae and palpi blackish; frontalia dark brown. Thorax black with faint metallic bluish tinge; silvery on humeri, pleura, and middle of prescutum; with four brown vittae, the outer heavy and confluent anteriorly with the inner. Abdomen blackish, faintly metallic greenish, thinly silvery laterally on bases of segments, the pollen extending across segments in oblique view. Legs black. Wings narrowly brown on costa. Tegulae whitish.

Type.—Cat. No. 22246, U.S.N.M.

Tribe HYALURGINI.

XANTHOCERA ATRA, new species.

Length, 4.5 mm. (abdomen arched). Two females, Alto Pass and Dubois, Illinois, May 7 and 21, 1917 (J. R. Malloch).

Differs from *clistoides* Townsend as follows: Abdomen wholly polished black, without sign of pollen. Thorax and scutellum shining black, but with faint indications of thin pollen coat in oblique view. Front a little wider, and clypeus not quite so depressed. No weak apical pair of scutellar bristles. Femora shining black to brown-black.

Type.—Cat. No. 22270, U.S.N.M.

Tribe LYDELLINI.

AUBAEANETIA, new genus.

Genotype.—Aubaeanetia assimilis, new species.

Clypeus moderately sunken. Epistoma cut off, not warped. Facialia ciliate at most about one-third way. Proboscis a little over half head height; palpi about as long as haustellum, a little widened at tip. Third joint of antennae in male about three times second and stout; in female twice second and not stout; in both submucronate. Arista short-pubescent. Three frontals below base of antennae. Two proclinate fronto-orbitals in both sexes. Ocellars strong. Parafacialia bare. Cheeks over one-fourth eye length. Two preacrostichals and postacrostichals; three sternopleurals, postintraalars, postsuturals and lateral scutellars; very weak apical scutellars. Costal spine strong. Third vein bristled about one-

third way to small crossvein; others bare. Apical cell open considerably before tip. Hind crossvein a little nearer to cubitus. Male claws not as long as last tarsal joint. Abdomen subcylindrical. Median marginal pair on first two segments; median discal pair on intermediate segments; marginal row on last two; submarginal and discal rows on anal.

AUBAEANETIA ASSIMILIS, new species.

Length, 6.5 to 7 mm. One male and one female, Franconia, New Hampshire, July 21 and 27, 1915, on foliage in woods (C. H. T. Townsend).

Shining black, more or less silvery. Palpi fulvous, darker basally. Antennae blackish. Frontalia brown. Rest of head silvery, with blackish reflections in varying light; occiput ashy. Thorax and abdomen shining, with silvery pollen thinly spread on former and on bases of last three segments of latter. Four indistinct black vittae on thorax before suture. Wings clear. Tegulae whitish.

Type.—Cat. No. 22244, U.S.N.M.

STOMATOLYDELLA, new genus.

Genotype.—*Stomatolydella infernalis*, new species.

Clypeus moderately sunken, not twice as long as wide. Epistoma short, well warped. Facialia ciliate to lowest frontals. Proboscis hardly two-thirds head height. Palpi stout, bowed, rather short. Third antennal joint over three times second, narrow. Arista crooked, pubescent. Eyes pilose. Male vertex one-fourth head width, the front nearly equilateral on posterior half or so. Two frontals below base of antennae. Two proclinate fronto-orbitals in male. Ocellars absent. Parafacialia bare, scarcely one-third as wide as clypeus, narrowing below. Cheeks less than one-fifth eye length. Three sternopleurals, postintraalars, postsuturals, preacrostichals, postacrostichals, and lateral scutellars; a pair of scars indicates a small apical pair. Third vein bristled only at base, others bare. Apical cell narrowly open a little before tip. Hind crossvein nearer to cubitus. Middle and hind metatarsi as long as following joints together. Hind tibiae pectinate on basal half, the bristles on distal half shorter. Abdominal macrochaetae short and weak; median marginal pair on first two segments, marginal row on third longer than others; anal segment with weak bristles over disk.

STOMATOLYDELLA INFERNALIS, new species.

Length, 6 mm. One male, Hell Canyon, Manzano Mountains, New Mexico, 7,200 feet, September 19, 1916, on foliage of scrub-oak (C. H. T. Townsend).

Dark brown. Head brassy-cinereous. Frontalia light brown. Palpi fulvo-rufous. Humeri and pleura thinly gray pollinose. Mesonotum soft blackish, with faint traces of brownish pollen; vittae subobsolete, five showing in front of suture, of which the outer on each side is wide and blotch-like. Abdomen pale brassy pollinose on irregular forward half of last two segments and on second segment each side of median line anteriorly, the median vitta of dark brown distinct throughout. Wings clear. Tegulae nearly white.

Type.—Cat. No. 22217, U.S.N.M.

ANAMETOPOCHAETA, new genus.

Genotype.—Anametopochaeta olindoides, new species.

Clypeus moderately sunken. Epistoma rather short, faintly warped. Facialia bare. Proboscis short, palpi moderately stout. Third antennal joint nearly three and one-fourth times second. Arista longer than antennae, pubescent halfway on upper side. Eyes somewhat thinly short-hairy. Female vertex nearly one-fourth head width; front but little widened anteriorly. Frontals aborted, consisting of about five microscopic short fine hairs, one slightly below base of antennae. Proclinate fronto-orbitals also aborted, represented by two microscopic short hairs. Two strong reclinate fronto-orbitals, and one strong reclinate vertical. No ocellars. Parafacialia bare. Cheeks about one-fourth eye length. Two sternopleurals, preacrostichals, and postacrostichals; three postintraalars, postsuturals, and lateral scutellars; minute apical scutellar pair. Third vein bristled only at base, others bare. Apical cell very narrowly open a little before tip. Hind crossvein considerably nearer to cubitus. Tarsi long. Median marginal pair on first two segments; marginal row on last two segments; weak discal row on anal segment. Female without sharp piercer.

ANAMETOPOCHAETA OLINDOIDES, new species.

Length, 6.5 mm. One female, Chaquimayo, Peru, 2,500 feet, February 5, 1910, on foliage (C. H. T. Townsend).

The coloration almost exactly agrees with Desvoidy's description of *Olinda brasiliensis*,[1] only the tegulae are yellowish. The long arista and the apical crossvein bowed in preclude identification with that genus. The black parts are antennae, frontalia, four thoracic vittae, narrow base of scutellum, first abdominal segment, irregular posterior half of last three segments, and legs. A faint narrow brown median vitta shows on abdomen. Palpi pale fulvous; proboscis brownish. All the rest is quite deeply golden pollinose. Wings faintly yellowish-smoky across middle and less so apically.

Type.—Cat. No. 22225, U.S.N.M.

[1] Essai Sur les Uyodaires, 1830, p. 116.

URODEXODES, new genus.

Genotype.—Urodexodes charapensis, new species.

Differs from *Paradexodes* as follows: Frontal profile about as long as facial. Proboscis about two-thirds head height. Third antennal joint about three times second, equilateral, subtruncate. Four or five frontals below base of antennae. No ocellars. Parafacialia in middle about one-fourth width of clypeus. Normally three postsuturals. No apical scutellars. Cubitus about one-fourth of wing breadth from hind margin. Anal segment of male as long as preceding segment; not caudate but tapered to a point, obliquely cut off below on posterior half in profile. Abdomen with short erect bristles in addition to the macrochaetae; only one strong median discal pair on intermediate segments.

URODEXODES CHARAPENSIS, new species.

Length, 9 to 10 mm. Two males, Rio Charape, Jaen Province, Peru, 4,500 feet, September 15 and 16, 1911 (C. H. T. Townsend).

Antennae, palpi and frontalia blackish; rest of head anteriorly quite thickly golden pollinose; the occiput ashy. Thorax and scutellum somewhat paler golden pollinose, former with four black vittae. Abdomen dark brown; last three segments pale golden pollinose, leaving an indistinctly defined and changeable triangular brown area on intermediate segments, and a brown reflection on disk of anal segment. Legs blackish. Wings faintly fuscous costally. Tegulae tawny, more or less glassy.

Type.—Cat. No. 22229, U.S.N.M.

PHRYNOLYDELLA, new genus.

Genotype.—Phrynolydella polita, new species.

Differs from *Lydella* as follows: Clypeus twice as long as wide or more. Facialia ciliate about halfway. Antennae inserted well above eye middle; third joint twice to three times second. Male frontalia no wider than one parafrontal in middle; those of female narrower than one parafrontal. Hind crossvein not far from cubitus. Male abdomen truncate posteriorly, not pointed; median discals not doubled. Intermediate segments lacking erect bristles.

PHRYNOLYDELLA POLITA, new species.

Length 5.5 to 9 mm. Numerous specimens of both sexes, Pinal Mountains, Chiricahua Mountains, Castle Butte, Arizona, Peloncillo Mountains, New Mexico, Sierra Madre, Chihuahua, 4,750 to 7,300 feet. (C. H. T. Townsend); and Williams, Arizona, Las Vegas Hot Springs, New Mexico. (H. S. Barber).

Shining black, thinly silvery pollinose. Face and front silvery, darker in varying lights; the inside of parafrontala very faintly and

almost imperceptibly brassy. Palpi fulvo-rufous. Four faint thoracic vittae, the inner ones narrow. Abdomen thinly silvery on forward half or so of last three segments, the pollen thickening basally. Tegulae white. Wings clear.

One of the females was labeled by Coquillett "*Masicera strigata* Wulp."

Type.—Cat. No. 22208, U.S.N.M.

AUSTROLYDELLA, new genus.

Genotype.—Austrolydella assimilis, new species.

Allied to *Stomatolydella*. Clypeus nearly twice as long as wide. Epistoma moderately warped. Facilia ciliate halfway. Proboscis little over half-head height; palpi thickened or widened at tip. Third antennal joint about two and one-half times second. Eyes thickly pilose in male, thinly so in female. Male front about one-fourth head width, equilateral throughout; female vertex not one-third head width. Ocellars moderately strong. Parafacialia as wide as facialia below in male, a little wider in female. Cheeks fully one-fifth eye length in both sexes. Three lateral scutellars, hind pair longest and more or less divaricate. A moderately long erect decussate apical pair of scutellars. Apical cell open some distance before tip. Tarsi short. Median marginal pair on first three abdominal segments; median discal pair on intermediate segments; and marginal and discal rows on anal segment; macrochaetae of normal length. Female with sharp piercer but without ventral carina or short spines. Otherwise mainly as in *Stomatolydella*.

AUSTROLYDELLA ASSIMILIS, new species.

Length, 6 to 6.25 mm. One male and one female, Santa Eulalia, Peru, 3,500 feet, April 28, 1914, on foliage (C. H. T. Townsend).

Blackish, silvery to golden pollinose. Male head and upper parts thinly silvery; female head and upper parts more thickly pollinose, distinctly golden, especially on front. Palpi subfulvous distally. Four blackish thoracic vittae. Pollen of abdomen more dense on basal half of last three segments; the posterior half of each segment and median vitta rather shining. Wings clear. Tegulae whitish.

Type.—Cat. No. 22222, U.S.N.M.

MEIGENIELLOIDES, new genus.

Genotype.—Meigenielloides cinerea, new species.

Clypeus gently sunken. Epistoma cut off, rim warped. Facialia bare. Proboscis very short; palpi stout and bowed. Third antennal joint about twice the elongate second, gradually widening to the subtruncate tip in female. Arista long, bare. Eyes bare. Female vertex not one-third head width. Three frontals below base of antennae. Two proclinate fronto-orbitals in female. Ocellars pres-

ent. Parafacialia bare. Cheeks fully one-third eye length. One preacrostichal; two postacrostichals; three sternopleurals, postintraalars, postsuturals and lateral scutellars; minute short hair-like apical scutellar pair. Third vein bristled only at base; others bare. Apical cell narrowly open well before tip. Hind crossvein a little nearer cubitus. Tarsi long. Median marginal pair on first two segments; median discal pair on intermediate segments; marginal row on last two segments; irregular discal row on anal segment.

MEIGENIELLOIDES CINEREA, new species.

Length, 7 mm. One female, Manzanares Creek, Pecos National Forest, New Mexico, 7,500 feet, August 30, 1916 (C. H. T. Townsend).

Slate-brownish, thickly cinereous pollinose over whole body. Palpi, basal half of antennae, and legs fulvous-yellowish; tarsi blackish. Four pale slate-colored thoracic vittae; a very faint median abdominal vitta of same color seen from directly above. Wings faintly yellowish along veins and costa. Tegulae glassy tawny-whitish.

Type.—Cat. No. 22226, U.S.N.M.

PROROGLUTEA, new genus.

Genotype.—Proroglutea piligera, new species.

Clypeus moderately sunken. Epistoma short, warped. Facialia bare. Proboscis short. Palpi stout, widened and flattened. Third antennal joint hardly three times second. Arista long and thin, bare. Eyes bare. Three frontals below base of antennae. Ocellars weak or vestigial. Parafacialia bare. Three sterno-pleurals, postintraalars, preacrostichals, postacrostichals, and lateral scutellars; four postsuturals; no apical scutellars. Third vein bristled only at base; others bare. Apical cell open a little before tip. Hind crossvein nearer to cubitus. Male abdomen stout-oval, pointed behind; ventrally the anal segment bears thick hair, meeting over the hypopygial slit. Median marginal pair on first two segments; median discal pair on intermediate segments; marginal row on last two segments; anal with short bristles on disk.

PROROGLUTEA PILIGERA, new species.

Length, 9.5 mm. Two males, San Carlos, Costa Rica (Schild and Burgdorf).

Brown, rather thickly brassy to pale golden pollinose. Palpi ulvous. Antennae blackish. Frontalia brown. Rest of head pale golden pollinose, as is thorax; four vittae and base of scutellum blackish. Abdomen golden pollinose on bases of last three segments, shading to silvery except on extreme base. Wings fuscous costally and along veins. Tegulae tawny.

Type.—Cat. No. 22252, U.S.N.M.

MYOTHYRIOPSIS, new genus.

Genotype.—Myothyriopsis bivittata, new species.

Clypeus shallow. Epistoma wide, not long, a little warped. Facialia bare. Proboscis hardly head height; palpi stout, bowed, widened at tip. Eyes bare. Frontals diverging one or two bristles below base of antennae. Third antennal joint three to four times second. Arista pubescent, basal joints short. No proclinate fronto-orbitals in male. Ocellars present. Parafacialia narrow, bare. Cheeks about one-fifth eye length. Four sternopleurals; three postintraalars, postsuturals, preacrostichals, postacrostichals and lateral scutellars. A moderately long decussate apical pair of scutellars. Third vein bristled halfway or so to small crossvein; other veins bare. Apical cell very narrowly open considerably before tip. Posterior crossvein nearly in middle between small crossvein and cubitus. First abdominal segment with a weak median marginal pair; second with a stronger median marginal pair; third and anal segments with marginal row. No sharp piercer in female.

MYOTHYRIOPSIS BIVITTATA, new species.

Length, 6 mm. Three females and two males, Chapada, Brazil (H. H. Smith).

Black, with golden pollen in stripes and fasciae. Head golden. Facial plate and facialia lead-gray, also at times the parafacialia; frontalia, two heavy thoracic vittae, and scutellum soft black. Antennae blackish. Palpi rufous or fulvous. Scutellum testaceous on tip. Abdomen shining black, slightly reddish on sides in male, the bases of last three segments broadly golden. Wings obliquely black costobasally from about middle of fifth vein to tip of third vein. Tegulae yellowish, the small scale white.

Type.—Cat. No. 22092, U.S.N.M.

Sphalloglandulus Townsend. This is the male of *Incamyia* Townsend. The genotypes are conspecific.

Tribe MEIGENIINI.

TOPOMEIGENIA, new genus.

Genotype.—Topomeigenia matutina, new species.

Clypeus moderately sunken. Epistoma elongate, considerably warped. Facialia ciliate about halfway. Proboscis short, palpi stout. Third antennal joint hardly three times second, narrow. Arista bare. Eyes nearly bare. Male vertex over one-fourth head width. Three frontals below base of antennae. Ocellars strong. Parafacialia bare, nearly equilateral, hardly half as wide as clypeus. Cheeks less than one-third eye length. Four sternopleurals, postsuturals, and lateral scutellars; three postintraalars, preacrostichals,

and postacrostichals; short erect decussate apical scutellar pair. Third vein bristled only at base, others bare. Apical cell open well before tip. Hind crossvein nearer to cubitus. Male claws long. No median marginals on first two segments; median row on last two. Hind tibiae ciliate, with a longer bristle.

TOPOMEIGENIA MATUTINA, new species.

Length, 8.5 mm. Two males, Topolobampo Bay, Sinaloa, Mexico, September 14, 1909, in company of numerous specimens buzzing loudly amongst foliage of shrubs near edge of bay before 6 o'clock in the morning (C. H. T. Townsend).

Antennae blackish, second joint tinged with rufous. Palpi fulvus. Frontalia brown. Rest of head dull silvery. Thorax and scutellum thickly dull silvery, more or less faintly brassy; with five blackish vittae, the middle one restricted to postscutum. Abdomen mostly rufous; basal half or more of last three segments pale brassy pollinose, the pollen thinning irregularly posteriorly on each segment; a dark median vitta present. Legs dark brown. Wings clear. Tegulae nearly white.

Type.—Cat. No. 22259, U.S.N.M.

PARAMEIGENIA, new genus.

Genotype.—Paradexodes albifacies Townsend 1908.[1]

Differs from *Paradexodes* as follows: Only two frontals below base of antennae in both sexes. Clypeus not longer than one and one-half times its width. No apical scutellar pair. Only two strong postacrostichals. Third antennal joint only twice second in both sexes. Arista thickened only at extreme base. Thorax no wider than abdomen.

OLLACHEA, new genus.

Genotype.—Ollachea elongata, new species.

Head characters of *Spylosia,* but epistoma warped. Parafacialia hairy on upper half. Cheeks nearly half eye length in female; less in male. Arista bare. Third antennal joint about twice the elongate second. Eyes bare. Ocellars present. Proboscis short; palpi clubbed. Three sternopleurals, postintraalers, preacrostichals, postacrostichals, and lateral scutellars; three or four postsuturals; only apical scutellar hairs; Third vein bristled only at base; others bare. Apical cell open a little before tip. Hind crossvein nearer to cubitus. Abdomen long, narrow, tapering to tip, flattened. Median marginal pair on first two segments; marginal row on last two; median discals on all segments but those of first and last segments vestigial in female; the median discals are doubled on intermediate segments

[1] Tax. Musc. Flies, p. 102.

and are stronger in the male, which, besides, has anal segment well covered with long erect bristles.

OLLACHEA ELONGATA, new species.

Length, 7 to 8 mm. Two males and one female, Ollachea, Peru, 9,500 feet, February 2, 1910, on flowers of *Buddleia* sp. (C. H. T. Townsend).

Blackish-brown, rather thickly brassy-cinereous pollinose. Palpi fulvous. Antennae black. Frontalia deep brown. Mesoscutem with two broad heavy blackish-brown vittae widened inwardly just behind suture, where they are more or less confluent; notched outwardly at suture, with an outer prong narrowly following suture behind, which is more distinct in the male. Scutellum brownish on disk, especially in the male. Abdomen with broad median vitta of brown, much widened on first segment, narrowly following hind borders of first three segments laterally. Wings nearly clear. Tegulae glassy, smoky-yellowish.

Type.—Cat. No. 22258, U.S.N.M.

OPSOMEIGENIA, new genus.

Genotype.—Hypostena pusilla Coquillett, 1895.[1]

General Meigeniine characters. Epistoma cut off short, not warped. Facialia bare. Eyes bare. One frontal below base of antennae, or at times two in male. Ocellars present. Parafacialia bare, moderately narrow, strongly narrowed below in female but less so in male. Two to three preacrostichals; three sternopleurals, postintraalers, postsuturals, postacrostichals, and lateral scutellars; no apical scutellars. Third vein bristled only at base; others bare. Apical cell narrowly open just before tip. Hind crossvein in middle. Male claws rather long. Median marginal pair on first two segments; median discal pair on intermediate segments in both sexes and on anal in female; marginal row on last two segments, discal row on anal in male.

MACHAIROMASICERA, new genus.

Genotype.—Machairomasicera carinata, new species.

Clypeus gently sunken. Epistoma short, scarcely warped. Facialia finely ciliate nearly halfway. Proboscis short; palpi stout. Third antennal joint over three times second in female. Arista long, bare. Eyes thinly pilose. Female vertex one-fourth head width. Two frontals below base of antennae. Two proclinate fronto-orbitals in female. Ocellars weak. Parafacialia narrow, bare. Cheeks about one-fifth eye length. Three sternopleurals, postintraalars, post-

[1] Journ. N. Y. Ent. Soc., vol. 3, p. 58; and in 1897 referred by its author to female of *Methypostema barbata* Coquillett, Rev. Tach., p. 62.

suturals, preacrostichals, post acrostichals and lateral scutellars; no apical scutellars. Third vein bristled over halfway to small crossvein, others bare. Apical cell open just before tip. Hind crossvein nearer to cubitus. Median marginal pair on first two segments, marginal row on last two. Female with sharp piercer and ventral carina, latter bearing very short spines on third segment only.

MACHAIROMASICERA CARINATA, new species.

Length, 7 mm. One female, below Manchi, Ecuador, 7,000 feet, November 22, 1910 (C. H. T. Townsend).

Head silvery, the sides of face and front golden. Palpi fulvous. Antennae blackish. Frontalia dark brown. Thorax and scutellum silvery, showing a slight brassy or ochreous tinge in places; leaving four black vittae and a short fifth median one behind suture. Abdomen subshining blackish, silvery pollinose on bases of intermediate segments and on basal half of anal; on venter and sides the pollen covers all except hind borders of segments. Legs blackish. Wings lightly smoky-yellowish on about costal half, the inner portion dilute or nearly clear. Tegulae pale fulvous.

Type.—Cat. No. 22247, U.S.N.M.

OCHROMEIGENIA, new genus.

Genotype.—Ochromeigenia ormioides, new species.

Clypeus deeply dished. Epistoma cut off at vibrissae, supplemented below by oral membrane. Facialia not ciliate half way. Proboscis about half head height, palpi stout. Third antennal joint two and one-half times second. Arista pubescent. Eyes bare. Frontals weak, stopping about base of antennae. No proclinate fronto-orbitals in male. Ocellars very weak. Parafacialia sparsely microsetose. Cheeks over one-fourth eye length. One preacrostichal and postacrostichal; two postintraalars and lateral scutellars; three sternopleurals and postsuturals; no apical scutellars, only bristly hairs. Third vein bristled over half way to small crossvein, others bare. Costal spine moderately long. Apical cell open just before tip. Hind crossvein about in middle. A weak median marginal pair on first segment and a strong one on second; strong marginal row on third and anal segments.

OCHROMEIGENIA ORMIOIDES, new species.

Length, 7 mm. One male, Mount Salak, Java, May 15, 1909 (Bryant and Palmer).

Pale fulvous to ochreous. Antennae pale rufous, fuscous at tip. Frontalia fuscous at anterior end, growing rufous posteriorly. Thoracic vittae obsolete. Abdomen increasingly rufous posteriorly. Tarsi pale, but appearing dark from the black vestiture. Wings nearly clear. Tegulae glassy-fulvous.

Type.—Cat. No. 22209, U.S.N.M.

ZOSTEROMEIGENIA, new genus.

Genotype.—Zosteromeigenia mima, new species.

Clypeus moderately sunken, epistoma elongate and in clypeal plane. Facialia bare. Proboscis short, palpi stout. Third antennal joint about three times second in male, narrow. Arista longer than antennae, long-pubescent about to tip. Eyes bare. Male vertex scarcely one-fourth head width. Three frontals below base of antennae. Ocellars present. Parafacialia bare, fully half as wide as clypeus, nearly equilateral. Cheeks fully one-fourth eye length. Three sternopleurals, postintraalars, postsuturals, presacrostichals, postacrostichals, and lateral scutellars; no apical scutellars. Third vein bristled only at base, others bare. Apical cell very narrowly open some distance before tip. Hind crossvein nearer to cubitus. Male claws very long. Median marginal pair on first two segments, marginal row on last two.

ZOSTEROMEIGENIA MIMA, new species.

Length, 7.5 mm. One male Hamilton, Upper North Pine, Queensland, January, 1890 (Department Mines and Agriculture).

Colored almost like *Zosteromyia cingulata* Macqart, differing only as follows: Palpi fulvous. Abdomen broadly fulvous-yellow on sides from first segment to middle of third segment, the dark part of intermediate segments subtriangular. Wings narrowly brown on costa. Tegulae fuscous on outer basal portion.

Type.—Cat. No. 22239, U.S.N.M.

Tribe EXORISTINI.

NEOSCOTIA, new name.

Genotype.—Tachina grandis Zetterstedt.

This new generic name is proposed for *Scotia* Robineau-Desvoidy (not Huebner), 1863.[1]

Tribe PHRYNOINI.

PHRYNOFRONTINA, new genus.

Genotype.—Phrynofrontina convexa, new species.

Clypeus well sunken, long. Epistoma short, warped. Facialia bare, the facial profile strongly bulged. Proboscis hardly head height; palpi short and stout. Third antennal joint long, stout, five times second or more. Arista long, thin except at base, bare. Eyes bare. Male vertex nearly or quite one-third head width. Two frontals below base of antennae. Ocellars present. Two proclinate fronto-orbitals in male. Parafacialia bare, nearly equilateral, less than half as wide as clypeus. Cheeks fully one-third eye length.

[1] Dipt. Env. Paris, vol. 1, p. 255.

Three sternopleurals, postintraalars, postsuturals, preacrostichals, postacrostichals, and lateral scutellars; hairlike apical scutellar pair. Costal spine long. Third vein bristled only at base, others bare. Apical cell narrowly open considerably before tip. Hind crossvein about in middle. Male claws short; median marginal pair on first two segments; median discal pair on intermediate segments; marginal row on last two; discal row on anal.

PHRYNOFRONTINA CONVEXA, new species.

Length, 6 mm. Two males, Chain Bridge, Maryland, and Difficult Run, Virginia, September 12 and 14, 1913 (R. C. Shannon).

Head silvery pollinose, shading to light golden on front. Frontalia pale brownish. Palpi pale fulvous. Antennae black. Thorax and scutellum pale brassy pollinose; four vittae. Abdomen shining dark brown; basal half or so of last three segments silvery pollinose with pale golden shade in some lights. Legs blackish. Wings clear. Tegulae tawny-whitish.

Type.—Cat. No. 22261, U.S.N.M.

EUTRITOCHAETA, new genus.

Genotype.—Eutritochaeta carpocapsae, new species.

Differs from *Tritochaeta* as follows: Palpi much swollen or widened at tip. Third antennal joint four to five times second; longer in male. Arista thickened less than halfway. Two verticals in both sexes. Female frontalia as wide as one parafrontal; those of male a little less. Moderately long decussate apical scutellar pair. No costal spine. Male claws as long as last tarsal joint. Median marginal pair on first two segments; marginal row on last two; discal row and bristles on anal.

EUTRITOCHAETA CARPOCAPSAE, new species.

Length, 6.5 to 7 mm. One male and one female reared by F. L. Wellman, at Bentonville, Arkansas, from two puparia taken from a single codling moth cocoon collected under a tree band; issued July 13, 1918.

Blackish, silvery to cinereous pollinose. Palpi fulvous. Antennae blackish, base faintly tinged with fulvous. Frontalia brown. Rest of head silvery-ashy, shading to pale golden on front. Thorax, scutellum, and abdomen cinereous pollinose, with faint golden cast, leaving four thoracic vittae; first abdominal segment, median abdominal vitta, and irregular hind borders of last three segments blackish and subshining; the black hind borders of intermediate segments extending forward more or less in triangle on each side. Wings clear. Tegulae whitish.

Type.—Cat. No. 22243, U.S.N.M.

Tribe ARGYROPHYLACINI.

MINTHOHOUGHIA, new genus.

Genotype.—*Minthohoughia cylindrica*, new species.

Head like *Houghia*. Clypeus deep, short. Facialia bare. Arista short-pubescent. Eyes bare. Female vertex not one-third head width. One frontal below base of antennae. Ocellars weak, strongly divaricate, feebly proclinate, or even reclinate. Parafacialia bare, narrowed below to a point. Cheeks about one-twelfth eye length. Two sternopleurals, preacrostichals, and lateral scutellars; three postintraalars and postsuturals; postacrostichals present; rather long decussate apical scutellar pair. Wings very short. Costal spine strong. Third vein bristled to point about opposite hind crossvein; others bare. Apical cell narrowly open considerably before tip. Hind crossvein in middle. Abdomen like *Mintho* in form. No median marginals on first segment, but a pair on second; strong marginal row on last two segments.

MINTHOHOUGHIA CYLINDRICA, new species.

Length, 5 to 6 mm. Two females, Lima, Peru, March 14, 1910, on foliage (C. H. T. Townsend).

Palpi very pale fulvous. Antennae blackish; second joint obscure rufous. Head and thorax thickly pollinose, with distinct golden-green tinge. Thoracic vittae scarcely perceptible. Abdomen shining rufous, bases of last three segments brassy-silvery; median vitta and last two segments shining blackish; the vitta broad and widening behind on second segment; the third segment broadly rufous on sides at base. Legs blackish. Wings nearly clear. Tegulae whitish.

Type.—Cat. No. 22256, U.S.N.M.

CASAHUIRIA, new genus.

Genotype.—*Casahuiria cornuta*, new species.

Clypeus broad, long, deeply sunken. Epistoma cut off, scarcely warped. Facialia strongly ciliate over half way. Proboscis about half head height, haustellum little longer than broad; palpi short, broad and flattened in male. Third antennal joint of male eight times second, wide. Arista bare. Eyes thinly short-hairy. Male vertex about one-fourth head width. Two or three frontals below base of antennae. Parafacialia very narrow, with some fine hairs above next frontals. Cheeks one-fifth eye length. Three each sternopleurals, postintraalars, postsuturals, preacrostichals, postacrostichals, and lateral scutellars; very weak apical scutellar pair. Third vein with one long bristle at base, others bare. Apical cell open a little before tip. Hind crossvein nearer to cubitus. Male

claws short. No median marginals on first segment; median marginal pair on intermediate segments; that on second short; marginal row on anal.

CASAHUIRIA CORNUTA, new species.

Length, 6.5 mm. One male, Casahuiri, Peru, 4,500 feet, February 4, 1910 (C. H. T. Townsend).

Dark brownish. Palpi and antennae blackish. Head thinly pale golden pollinose. Thorax and scutellum showing thin coat of ashy to ochreous pollen in oblique view, with four indistinct black vittae. Abdomen brown, with same thin pollen coat, the pollen showing densely on narrow bases of last three segments and widening on sides, leaving a narrow black median vitta. Wings infuscate on basocostal half or so, diluted apically and on inner border. Tegulae smoky.

Type.—Cat. No. 22242, U.S.N.M.

Tribe CARCELIINI.

GYMNOCARCELIA, new genus.

The characters of this genus are indicated in the description of the species.

Genotype.—Gymnocarcelia ricinorum, new species.

GYMNOCARCELIA RICINORUM, new species.

This name is proposed for *Sturmia albifrons* Coquillett 1897.[1] The species is doubtfully the same as *Tachina albifrons* Walker 1856,[2] from the United States, which name in any event is preoccupied by *Tachina albifrons* Walker 1837,[3] from South America.

The genus is at once distinguished from all other Carceliini by the quite bare eyes. The type-specimens were reared by Mr. Max Kisliuk, jr., at Allapata, Florida, from *Apantesia phyllira* Drury found feeding on *Ricinus communis*. The species has been reared from various Arctians.

EOCARCELIA, new genus.

Genotype.—Eocarcelia ceylanica, new species.

Clypeus well sunken. Epistoma moderately short, a little warped. Facialia bare. Proboscis short, labella large. Palpi stout, bowed, widened. Third antennal joint about three times the rather long second. Arista long, slender, bare. Eyes thickly pilose. Male vertex rather over one-fifth head width. Three frontals below base of antennae. Ocellars strong. Parafacialia narrow, bare. Cheeks about one-eighth eye length. Two sternopleurals; three postintraalars, preacrostichals, postacrostichals, and lateral scutellars; four postsuturals; long decussate apical scutellar pair. Third vein

[1] Rev. Tach., p. 110.
[2] Trans. Linn. Soc. London, vol. 17, p. 351.
[3] Ins. Saund. Dipt., p. 283.

bristled only at base; others bare. Apical cell open considerably before tip. Hind crossvein nearer to cubitus. Male claws short. Hind tibiae pectinate, with longer bristle. Well-separated median marginal pair on first two segments; marginal row on third; marginal and two discal rows of weaker bristles on anal segment.

EOCARCELIA CEYLANICA, new species.

Length, 8.5 mm. One male, Peradeniya, Ceylon, May 29, 1914 (A. Rutherford).

Antennae blackish, articulation tinged with rufous. Palpi pale fulvous. Frontalia dark brown. Sides of front and face thinly silvery. Thorax and scutellum pale brassy pollinose; four thoracic vittae, the inner very narrow. Abdomen thickly brassy-silvery pollinose, leaving first segment and hind borders of last three blackish, also an indistinct median vitta. Legs blackish. Wings clear. Tegulae whitish.

Type.—Cat. No. 22260, U.S.N.M.

Tribe STURMIINI.

NEOWINTHEMIA, new genus.

Genotype.—Neowinthemia abdominalis, new species.

Allied to *Winthemia*. Facialia bare. Epistoma moderately short, scarcely warped, well narrowed from clypeus. Palpi heavy, bowed. Third antennal joint little over one and one-half times second. Eyes thickly pilose. Ocellars present. Parafacialia setose in three rows, narrowed considerably below. Cheeks about one-sixth eye length in male. Two sternopleurals; three postintraalars, preacrostichals, postacrostichals, and lateral scutellars; four postsuturals; short decussate apical scutellar pair. Male hind tibiae thickly ciliate, without longer bristle. Male claws long. No median marginals on first two segments, marginal row on last two, anal segment thickly bristly.

NEOWINTHEMIA ABDOMINALIS, new species.

Length, 9.75 mm. One male, Dixie Landing, Virginia, July 21, 1914, on foliage (C. H. T. Townsend).

Palpi deep rufous. Antennae blackish. Frontalia brown. Head silvery pollinose, with golden tinge especially on sides of front. Humeri and pleura thinly pollinose, mesoscutum shining brownish with faint pollen and scarcely visible vittae, scutellum testaceous. Abdomen blackish on first segment; the rest of tergum heavily silvery-cream pollinose, except a narrow black median vitta, which expands on second segment; sides of abdomen broadly rufous as seen from below. Legs blackish. Wings clear. Tegulae tawny.

Type.—Cat. No. 22254, U.S.N.M.

SCHAUMIA DESVOIDYI, new name.

This name is proposed for *Tachina bimaculata* Robineau-Desvoidy (not Hartig) 1863.[1]

Tribe CROCUTINI.

XEOPROSOPA, new genus.

Genotype.—Xeoprosopa uruhuasi, new species.

Clypeus long, narrow, flush. Epistoma cut off, not warped. Facialia bare, half as wide as clypeus. Vibrissae inserted below middle of oral margin. Proboscis about one and one-half times head height; palpi long, moderately stout. Third antennal joint about four times second. Arista long, pubescent, second joint elongate. Eyes bare. Frontals weak, stopping at base of antennae. Two proclinate fronto-orbitals in male. Ocellars weak. Parafacialia bare, as wide as facialia. Cheeks one-fifth eye length. No preacrostichals; one postacrostichal; three sternopleurals, postintraalars, and postsuturals; two lateral scutellars; no apical scutellars, only hairs. First vein bristled to tip, third half way or more to small crossvein; others bare. Apical cell closed tightly in tip. Hind crossvein nearer to cubitus. Tarsi of male elongate. No median marginals on first two segments; median marginal pair on third; marginal row on anal segment.

XEOPROSOPA URUHUASI, new species.

Length, 7 mm. One male, Uruhuasi, Peru, 6,500 feet, February 3, 1910, on flowers of *Baccharis* (C. H. T. Townsend).

Antennae black. Frontalia deep velvety blackish-brown. Facial plate, parafacialia, and parafrontalia burnished silvery-white, variable in changing lights. Palpi yellowish, tips dark. Mesonotum brown; the vittae nearly obsolete. Humeri and pleura silvery to ashy. Abdomen fulvous, becoming rufous on median line and posterior half, the tip of anal segment and fragmentary median line on third and anal segments blackish. Wings lightly yellowish-smoky, increasing costally. Tegulae pale yellowish.

Type.—Cat. No. 22214, U.S.N.M.

CROCUTA LUTEA, new species.

Length, 4.5 mm. Two females, Franconia, New Hampshire, July 20 and 21, 1915 (C. H. T. Townsend).

Almost entirely pale yellow. Third antennal joint and arista strongly tinged with fuscous. Tarsi fuscous. Wings clear. One or two bristlets usually on first vein before tip. Third vein usually bristled a little beyond small crossvein. Tegulae tawny-whitish. Four postsuturals and postacrostichals.

Type.—Cat. No. 22266, U.S.N.M.

[1] Dipt. Env. Paris, vol. 2, p. 44.

Tribe BIGONICHETINI.

PACHYNOCERA, new genus.

Genotype.—Pachynocera petiolata, new species.

Clypeus moderately sunken. Epistoma cut off short, the edge bulged. Facialia bare. Proboscis little over half head height; palpi well widened. Third antennal joint of male five or six times second and swollen. Arista rather short, bare. Eyes bare. Front wide and short; male vertex fully one-third head width. Two frontals below base of antennae. Row of five to seven proclinate fronto-orbitals in male. Ocellars present. Parafacialia narrow, with row of six to eight strong facio-orbitals. Cheeks two-fifths eye length. Two lateral scutellars; three sternopleurals, postintraalars, postsuturals, preacrostichals, and postacrostichals; rather long decussate apical scutellar pair. First vein bristled about two-thirds way to tip; third vein bristled to point about opposite hind crossvein; fifth vein bare. Apical cell petiolate, the petiole longer than small crossvein to over twice same, ending considerably before tip. Hind crossvein in middle or nearer to small crossvein. Male claws and tarsi short. No median marginals on first segment, but a pair on second; marginal row on last two segments.

PACHYNOCERA PETIOLATA, new species.

Length, 6 mm. Two males, Rio Charape, Jaen Province, Peru, 4,500 feet, September 12 and 13, 1911 (C. H. T. Townsend).

Shining black, with a faint metallic greenish tinge, more or less thinly silvery. Palpi fulvous. Antennae blackish, the base narrowly rufous. Frontalia brown. Face and sides of front rather thinly silvery, with blackish reflections in varying light. Thorax thinly silvery, more thickly so before suture and on pleura; with four indistinct black vittae, the inner and outer of each side approximated and without pollen between. Abdomen thinly silvery on basal half of anal segment and less than basal half of intermediate segments. Legs black. Wings fuscous on narrow costal border. Tegulae tawny-whitish.

Type.—Cat. No. 22248, U. S. N. M.

XANTHOACTIA, new genus.

Genotype.—Lasioneura palloris Coquillett, 1895.[1]

Differs from *Gymnophthalma* as follows: First vein bristled only on about the distal third. Third vein bristled more or less fully nearly to tip. Fifth vein entirely bare. Apical cell open to nearly or quite closed, ending in tip. Weak appressed marginal row on first segment; nearly complete marginal row on second, of which middle pair

[1] Journ. N. Y. Ent. Soc., vol. 3, p. 50.

is erect; last two segments with erect marginal row, no discals on anal segment. Three sternopleurals, postintraalars, preacrostichals, postacrostichals and lateral scutellars; four postsuturals; short apical scutellar pair. The disk of scutellum shows a short pair and is evenly set with michrochaetae surrounded by a conspicuously wide bare margin.

APHANTORHAPHA, new genus.

Genotype.—Aphantorhapha arizonica, new species.

Clypeus slightly depressed. Epistoma very short, slightly warped. Facialia bare. Haustellum three-fifths of head height; palpi small, widened at tip. Third antennal joint of male thick, about four times second. Arista short, thickened nearly to the sharp tip; second joint one-fourth as long as third. Eyes bare. Frontals in straight line, one below base of antennae. Two proclinate fronto-orbitals in male. Parafacialia very narrow, bare. Cheeks one-third eye length. Thoracic suture extinct throughout. Three sternopleurals, postintraalars, postsuturals, and lateral scutellars; preacrostichals and postacrostichals present; a microscopic nondecussate apical pair. Third vein bristled in about four bristles to small crossvein; others bare. Apical cell almost closed just before tip. Posterior crossvein straight, nearer to small crossvein. Last section of fifth vein over half as long as preceding section. No median marginals on first segment, but a pair on second; marginal row on third and anal segments.

APHANTORHAPHA ARIZONICA, new species.

Length, 3 mm. One male, Horseshoe Canyon, Chiricahua Mountains, Arizona, 6,000 feet, July 31, 1917, on flowers of *Ceanothus fendleri* Gray (C. H. T. Townsend).

Head very pale fulvous, thinly whitish pollinose. Frontalia fulvous. Antennae and arista black. Palpi pale yellowish. Thorax and abdomen brownish, thinly pollinose, rather shining. Pollen of mesonotum and abdomen with a brassy tinge, that of pleura less so. Median vitta and hind borders of abdominal segments brownish, shining. Legs brown or blackish. Wings clear. Tegulae tawny.

Type.—Cat. No. 22212, U.S.N.M.

TRICHOTOPTERYX, new genus.

Genotype.—Trichotopteryx tropica, new species.

Clypeus gently sunken. Epistoma short, well warped. Facialia bare. Proboscis short and stout; palpi widened at tip. Third antennal joint three and one-half times second. Arista finely pubescent; second joint twice as long as wide. Eyes nearly bare. Frontals stopping at base of antennae. Two proclinate fronto-obitals in male. Ocellars present. Parafacialia bare. Cheeks nearly one-

half eye length. Four postsuturals; three sternopleurals, postintraalars, preacrostichals, postacrostichals, and lateral scutellars; small nondecussate apical scutellar pair. First vein bristled to tip, third halfway to tip, fifth one-fourth way to hind crossvein. Apical cell narrowly open in tip. Hind crossvein a little nearer to small crossvein. No median marginals on first segment, but a pair on second; marginal row on third and anal segments.

TRICHOTOPTERYX TROPICA, new species.

Length, 6.5 mm. One male, Uruhuasi, Peru, 6,500 feet, February 3, 1910, on flowers of *Baccharis* (C. H. T. Townsend).

Head dull rufo-fulvous, thinly gray pollinose. Parafrontalia and antennae blackish; frontalia brown. Palpi rufous. Thorax and scutellum blackish, very thinly gray pollinose; humeri and pleura more thickly pollinose; four indistinct narrow thoracic vittae. Abdomen and hind femora fulvous-yellow; anal segment, greater part of third segment, and median vitta on second segment rufous to brown; darker posteriorly. Front and middle femora and tibiae and hind tibiae obscurely fulvous to rufous; tarsi blackish. Wings lightly smoky-yellowish; more so costally. Tegulae obscure fulvous.

Type.—Cat. No. 22211, U.S.N.M.

Tribe GERMARIINI.

INCAMYIOPSIS, new genus.

Genotype.—Incamyiopsis imitatrix, new species.

Clypeus well sunken. Epistoma short, well warped. Facialia strongly ciliate two-thirds way. Proboscis about head height; palpi stout and clubbed. Third antennal joint of female about two and one-half times second. Arista thickened nearly to the sharply pointed tip; basal joints short. Eyes rather thickly pilose. Female vertex nearly one-half head width. Three frontals below base of antennae. Two proclinate and two reclinate fronto-orbitals in female; the hind one in each case divaricate. Ocellars strongly divaricate-proclinate. Parafacialia bare, fully half as wide as clypeus. Cheeks over half eye length. Two postintraalars, postsuturals, preacrostichals, and postacrostichals; three sternopleurals and lateral scutellars; microscopic apical pair of scutellars. Costal spine very strong. Third vein bristled only at base; others bare. Apical cell closed well before tip. Hind crossvein nearer to cubitus. No median marginals on first segment; median marginal and median discal pairs on second; marginal row and median discal pair on third; weak marginal and submarginal and stronger discal rows on anal segment.

INCAMYIOPSIS IMITATRIX, new species.

Length, 4.5 mm. One female, Oroya, Peru, 12,000 feet, March 6, 1913, on herbage (C. H. T. Townsend).

Imitates *Incamyia cuzcensis* in general coloration and especially in coloration and appearance of head, but has three heavy black thoracic vittae instead of two. Antennae and palpi black. Face and front silvery-white; the parafrontalia with a blackish maculation posteriorly and a fainter smaller one anteriorly in changing lights. Frontalia and three heavy wide thoracic vittae soft brown-black; middle vitta extending over whole scutellum. Four creamy-silvery vittae narrower than the black ones, shading to golden posteriorly, and pleura with two large subconfluent golden spots. Abdomen shining brown, rather thinly buff-gold pollinose on first two segments; the pollen more concentrated on base of second segment and thickly so on less than basal half of last two segments, the rest of which is without pollen. Wings nearly clear, yellowish costobasally. Tegulae buff-yellow.

Type.—Cat. No. 22221, U.S.N.M.

METATACHINA, new genus.

Genotype.—Metatachina mellifrons, new species.

Clypeus nearly flush. Epistoma very short, faintly warped. Facialia bare. Proboscis little over half head height; palpi long and stout. Third antennal joint over twice second in female. Arista long, bare. Eyes bare. Female vertex a little less than one-third head width. Three frontals below base of antennae. Two proclinate fronto-orbitals in female. Ocellars present. Parafacialia bare, about one-third width of clypeus below. Cheeks less than one-third eye length. Three sternopleurals, postintraalars, postsuturals, preacrostichals, postacrostichals, and lateral scutellars; short divaricate apical scutellar pair. Third vein bristled only at base; others bare. Hind crossvein nearer to cubitus. Median marginal pair on first two segments; median discal pair on intermediate segments; marginal row on last two segments; submarginal and discal irregular rows on anal.

METATACHINA MELLIFRONS, new species.

Length, 7 mm. One female, Sebago Lake, Maine, September 8, 1914, on foliage (C. H. T. Townsend).

Palpi straw-colored. Antennae blackish. Frontalia brown. Occiput silvery; rest of head light golden pollinose. Thorax and abdomen rather thickly silvery, with faint brassy tinge; four rather narrow black thoracic vittae; first abdominal segment and irregular hind borders of last three segments subshining dark brown, but first segment showing pollen in oblique view. Legs blackish. Wings clear. Tegulae whitish.

Type.—Cat. No. 22245, U.S.N.M.

Tribe SALMACIINI.

ARAVAIPA, new genus.

Genotype.—Aravaipa atrophopoda, new species.

Clypeus moderately sunken. Epistoma not very long, strongly warped. Facialia ciliate. Proboscis nearly head height; palpi slender. Antennae inserted on eye middle, the antennal axis only half head height. Third antennal joint three times the elongate second. Arista very short, erect, geniculate, thickened to sharp point; second joint half as long as third. Eyes bare. Three frontals below base of antennae. Two proclinate and six reclinate fronto-orbitals in female. Ocellars present, reclinate. Cheeks fully one-fourth eye length. Four sternopleurals and postsuturals; three postintraalars, preacrostichals, postacrostichals, and lateral scutellars; one short decussate apical scutellar pair. Third vein bristled nearly to small crossvein; others bare. Costal spine present. Apical cell petiolate ending far before tip; petiole twice as long as small crossvein. Cubitus over two-fifths of wing breadth from hind margin, without stump. Hind crossvein considerably nearer to cubitus. Median marginal pair on first two segments, marginal row on last two. Front metatarsi of female longer than following joints together. Female front tarsi plump, swollen, metatarsi subcompressed, claws minute.

ARAVAIPA ATROPHOPODA, new species.

Length, 8 mm. One female, Rio Aravaipa, Arizona, 2,500 feet, August 29, 1917 (C. H. T. Townsend).

Black, silvery pollinose. Head silvery-white. Second antennal joint and base of third rufous. Palpi fulvous. Frontalia brown. Mesoscutum and scutellum rather thickly silvery, former with four nearly equal black vittae and with a golden-brown shade over the vittate portion. Front half or more of last three abdominal segments silvery-white, the rest shining black. Wings nearly clear. Tegulae white.

Type.—Cat. No. 22213, U.S.N.M.

Tribe GYMNOCHETINI.

CHARAPEMYIA, new genus.

Genotype.—Charapemyia calida, new species.

Clypeus flush. Epistoma very long, strongly warped in curve from clypeus. Facialia ciliate about one-third way. Haustellum fully half head height, palpi slender and elongate. Third antennal joint about four times second in male. Arista only microscopically pubescent. Eyes densely very long-pilose. Male vertex about one-sixth head width. Three frontals below base of antennae. No proclinate fronto-orbitals in male. Ocellars strong. Parafacialia bare. Cheeks

over one-third eye length in male. Two preacrostichals and lateral scutellars; three sternopleurals, postintraalars, postsuturals and postacrostichals; long decussate apical pair of scutellars. Third vein bristled only at base; others bare. Apical cell open well before tip. Hind crossvein less than its length from cubitus. Male claws very long. No median marginals on first segment but a pair on second, median discal pair on intermediate segments, marginal row on last two segments, and discal row on anal.

CHARAPEMYIA CALIDA, new species.

Length, 7 mm. Two males, Rio Charape, Jaen Province, Peru, 3,700 feet, September 19, 1911 (C. H. T. Townsend).

Subshining blackish, thinly silvery pollinose. Head more thickly pollinose, with distinct golden tinge. Palpi fulvous. Third antennal joint largely rufous. Four indistinct blackish thoracic vittae. Abdominal pollen indistinctly spread but more dense basally on last three segments. Wings clear. Tegulae glassy-white.

Type.—Cat. No. 22223, U.S.N.M.

CHRYSOTACHINA PERUVIANA, new species.

Length, 8 to 9 mm. Seven males and seven females; 11 from Chosica, one each from Santa Eulalia, Lima, and Piura, Peru. (C. H. T. Townsend.)

Differs from Wiedemann's description of *reinwardtii* as follows: Antennae largely smoky-rufous; second joint distinctly metallic gold-green; third joint mostly brownish, twice as long as second in both sexes. Head golden-yellow pollinose in both sexes, the parafrontalia largely showing gold-green at least posteriorly. Frontalia light brown. Abdomen, scutellum, and thorax concolorous, usually gold-green, but at times with bluish or purplish cast.

Type.—Cat. No. 22275, U.S.N.M., from Chosica.

NEOERIGONE, new genus.

Genotype.—*Neoerigone cinerea*, new species.

Clypeus flush. Epistoma wide, elongate, considerably warped. Facialia bare. Proboscis about head height; palpi heavy, widened in male, much swollen in female. Third antennal joint about two and one-half times second. Arista nearly bare; basal joints short. Eyes pilose. Frontals two to three below base of antennae. No proclinate fronto-orbitals in male. Ocellars present. Parafacialia bare. Cheeks about one-third eye length. Two sternopleurals; three posintraalars, postsuturals, preacrostichals, postacrostichals and lateral scutellars. A weak decussate apical pair of scutellars. Third vein bristled over halfway to small crossvein; other veins bare. Apical cell open well before tip. Posterior crossvein nearer to cubitus. No

median marginals on first abdominal segment; a medium marginal pair on second; marginal row on third and anal; a median discal pair on second and third; a discal row on anal.

NEOERIGONE CINEREA, new species.

Length, 9 mm. One male and two females, Chapada, Brazil (H. H. Smith).

Blackish, cinereous pollinose. Head silvery, parafrontalia tinged with golden; frontalia brownish. Antennae largely rufous. Palpi fulvous. Four dark thoracic vittae. Changeable blackish spots on abdomen from hind margin of second segment posteriorly; viewed from above there are four such spots on hind margin of second and third segments, and two on front margin of third and anal segments. Wings nearly clear. Tegulae white.

Paratype.—Cat. No. 22091, U.S.N.M.

Type in American Museum of National History.

Tribe LINNAEMYINI.

COPECRYPTA ANDINA, new species.

Length, 6 to 7.5 mm. Many specimens of both sexes, Verrugas Canyon, Peru, 5,500 feet, June 25 to July 23, 1913, on flowers of *Telanthera* (C. H. T. Townsend).

Differs from *ruficauda* Wulp by the sides of abdomen being rufous to fulvous, quite distinctly so in female and very broadly and conspicuously so in male. Legs fulvous; only the tarsi black.

Type.—Cat. No. 22276, U.S.N.M.

Tribe CHIRICAHUIINI.

BEZZIMYIA, new genus.

Genotype.—Bezzimyia busckii, new species.

General characters of *Chiricahuia*, differing principally as follows Ptilinal suture ending in the cheek grooves, not reaching lateral oral margin. Parafacialia narrow, narrowed below, with only a row of fine closely placed bristlets on upper part. Facialia bristly about halfway up. Male third antennal joint swollen, nearly six times the very short second. Male vertex about one-fifth head width. Antennae inserted slightly below eye middle, the front rather long. Arista inserted at extreme base of third antennal joint. Frontals stopping at base of antennae. Frontalia very narrow. Vertical bristles very short, but the outer is proclinate. Ocellars present, but very small and short, as are the frontals. Cheeks about half eye length. Third vein not bristled. Apical crossvein absent. Hind crossvein extremely close to small crossvein, only a little out of line with it. The abdomen is without true macrochaetae. Tibiae and

tarsal joints thickened, not elongate. Male claws short. Thoracic chaetotaxy very similar, but all the bristles much reduced in size.

BEZZIMYIA BUSCKII, new species.

Length, 5 mm. One male, Trinidad Rio, Panama, February 17, 1912 (A. Busck).

Dusky brownish, faintly pollinose. Palpi small, short, fulvous. Third antennal joint and arista clear orange, the basal joints obscurely so. Frontalia brown. Rest of head very faintly silvery, as is the thorax; latter shows indistinctly two heavy brown vittae. Scutellum and abdomen brown, without distinct pollen. Legs brown, femora more or less rufous. Wings slightly fuscous, with a clear streak near costa on basal two-thirds. Tegulae small, glassy-whitish or faintly tinged.

Type.—Cat. No. 22263, U.S.N.M.

Tribe CUTEREBRINI.

ATRYPODERMA, new genus.

Genotype.—*Musca americana* Fabricius; equals *Trypoderma americana* Wiedemann.

Differs from *Cuterebra* (type, *cuniculi* Clark) as follows: Mesoscutum at most scarcely as long as wide. Abdomen no wider than thorax. Front not prominently produced, the front border of head viewed from above subarcuate. Antennal axis little over half head height. Whole outline of head and body viewed from above equilateral and subquadrangular.

Cuterebra has the mesoscutum fully as long as wide; the abdomen very conspicuously wider than thorax; the front strongly produced, the head viewed from above being subtriangular; the antennal axis nearly two-thirds head height; the outline of head and body viewed from above strongly contrasted with that of *Atrypoderma* and quite *Bombus*-like. *Cuterebra maculosa* Knab, described from Panama, belongs in *Cuterebra*.

RECENT FORAMINIFERA FROM OFF NEW ZEALAND.

By Joseph A. Cushman.
Of the Boston Society of Natural History.

The material sent me for study by the United States National Museum consisted of four slides with over 1,200 specimens, representing nearly 200 species. The material was sent to the National Museum by Miss Marjorie and Mr. R. L. Mestayer, of Wellington, New Zealand. The locality for the material is off the "Poor Knights" Islands, east coast of New Zealand, latitude 35° 30′ S.; longitude 174° 43′ E., dredged by H. M. S. *Hinemoa*.

This material contains a few specimens which belong evidently to new species and varieties, and others which are especially interesting as representing rare species previously dredged in this region by the *Challenger*, and described by Brady, such as *Technitella raphanus* and *Frondicularia compta*. This material has been compared with that dredged by the *Challenger* at station 169 at a depth of 700 fathoms, also off New Zealand. It may be compared with Chapman's material from off Great Barrier Island, New Zealand, at a depth of 100 fathoms, and Sidebottom's material, dredged by the *Dart*, from off Australia, at 465 fathoms.

References are given in the synonymy to both Chapman's and Sidebottom's papers, as well as to other records for the region.

A study of this material shows that the general distribution is that of the Indo-Pacific region. Some specimens recorded by Heron-Allen and Earland from the Kerimba Archipelago are found as far to the south and east as this region. Others are the same as those already recorded from southern Japan, the Hawaiian Islands, the Philippines, the Malay Archipelago, etc.

In general this seems to be a very well defined faunal area and it is probable that many of the species found here are limited to this general region.

This New Zealand material contains a great number of Lagenidae which is similar to that of Chapman's and Sidebottom's material, as well as that which I have had from the Philippines in comparatively deep water. Heron-Allen and Earland, in their Kerimba material

have very few Lagenidae, probably on account of the shallow water from which most of their material came.

The species and varieties which have been found in the material follow in systematic sequence.

A few of the new or otherwise noteworthy species are figured in the two plates which accompany this paper.

Family ASTRORHIZIDAE.

Subfamily SACCAMMININAE.

Genus PSAMMOSPHAERA F. E. Schulze, 1875.

PSAMMOSPHAERA FUSCA F. E. Schulze.

Psammosphaera fusca F. E. SCHULZE, II Jahre Comm. wiss. Unt. deutsch. Meer in Kiel, 1875, p. 113, pl. 2, figs. 8*a–f*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 249, pl. 18, figs. 1, 5–8 (not 2–4).—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 35, figs. 25–28 (in text).

There are two specimens of small size, angular in shape, made up entirely of clear sand grains, broken sponge spicules, and little cement. This is not at all the usual form of test for this species. The general color is grayish white. They evidently correspond to the material noted by Sidebottom.

PSAMMOSPHAERA PARVA Flint.

Plate 75, fig. 3.

Psammosphaera parva FLINT, Rep. U. S. Nat. Mus., 1897 (1899), p. 268, pl. 9, fig. 1.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 36, figs. 29 and 30 (in text).

There are a few specimens in the material which are attached to, or perforated by, one large acicular sponge spicule. The test itself, however, is not at all of the usual form, but is angular, made up of large rough sand grains and broken spicules. Occasionally pointed spicules extend out from the test. In one specimen more or less calcareous material is incorporated in the test.

Genus TECHNITELLA Norman, 1878.

TECHNITELLA RAPHANUS H. B. Brady.

Technitella raphanus H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 247, pl. 25, figs. 13, 14.—CHAPMAN, Zool. Results, *Endeavour*, pt. 3, 1912, p. 310; vol. 3, pt. 1, 1915, p. 319.—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 1002.

There are three specimens that seem to belong to this very rare species. The shortest of these is about 5 mm. in length and the longest about 10 mm., which is much larger than the type specimen described by Brady. The form, however, is very much smaller than that of Brady's figured specimen. The test itself is composed entirely

of fragments of sponge spicules cemented in such a way that the free ends extend toward the small end of the test. The aperture is contracted and ends of the spicules brought in apparently to form a protection for the animal. The interior is rather smoothly finished and there seems to be no lining membrane. All the records for this species are in the South Pacific region. Brady's original specimens were from a *Challenger* station off Kandavu, Fiji Islands, in 210 fathoms. Chapman's specimens come from latitude 42° 17′ S.; longitude 148° 51′ E., in 1,122 fathoms, east of Tasmania. Pearcey records two or three specimens in the *Scotia* material from station 420, latitude 69° 33′ S.; longitude 15° 19′ W., in 2,620 fathoms. This material is therefore from the shallowest station yet recorded.

TECHNITELLA MESTAYERI, new species.

Plate 74, fig. 4.

Description.—Test elongate, slightly tapering, cylindrical, arcuate; wall composed of fine acicular sponge spicules, with a very little grayish cement; initial end broadly rounded; apertural end truncate with a slight lip; color grayish yellow; surface fairly smooth. Length, 3 mm.

Two specimens in this material are peculiar in their very small size, form, and general character of the test. They evidently represent a new species of this genus in the region. It is somewhat allied to *T. legumen* Norman, but is much longer, more nearly cylindrical than that species and the wall is differently built.

Type.—Cat. No. 14740, U.S.N.M.

Genus THOLOSINA Rhumbler, 1895.

THOLOSINA VESICULARIS (H. B. Brady).

Placopsilina vesicularis H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 51, pl. 5, fig. 2; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 316, pl. 35, figs. 18, 19.

Tholosina vesicularis Rhumbler, Arch. Prot., vol. 3, 1903, p. 227, fig. 53 (in text).—Cushman, Bull. 104, U. S. Nat. Mus., pt. 1, 1918, p. 65.

There are three specimens which are here referred to this species, all attached to shell fragments. The wall is composed of broken sponge spicules and clear quartz fragments, some of them of fairly large size. Mixed with these are very fine sand grains and grayish cement. The periphery is even and extends out into straight cylindrical tubular extensions. There is no sign of branching of these in any of the specimens, and as a rule they stand out clear from the substratum and are not attached, except at their base. They correspond very closely in general appearance with the specimens figured by Brady (*Challenger*, pl. 35, fig. 19.)

Subfamily HYPERAMMININAE.

Genus HYPERAMMINA H. B. Brady, 1878.

HYPERAMMINA LAEVIGATA J. Wright.

Hyperammina elongata H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 257, pl. 23, figs. 9, 10 (not 3, 7, 8).

Hyperammina elongata H. B. BRADY, var. *laevigata* J. WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 466, pl. 20, fig. 1.

Hyperammina laevigata CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 1, 1918, p. 77, pl. 29, figs. 5, 6.

Two specimens of this species, showing the proloculum, and two others showing simply the tubular portion, are shown on the slides.

HYPERAMMINA MESTAYERI, new species.

Plate 74, fig. 3.

Description.—Test elongate, cylindrical, arcuate, varying little in diameter throughout its length; initial portion hardly, if at all, enlarged; apertural end contracted to form a circular opening; wall thick, composed of very short fragments of sponge spicules and a few quartz grains; the fragments of spicules are variously crossed, the free ends pointing backward; color light grayish brown.

Diameter 1.25 mm.; length up to 16 mm.

There are four specimens of this form, which is apparently microspheric, in which the proloculum is small and the length maximum. There are three other specimens which agree with these in all points of structure and in which the initial end is considerably greater, its diameter being 2 mm. or more, but gradually tapers toward the apertural end, and the longest of the three specimens is 5 mm in length. These apparently represent the megalospheric form of the same species. It is evidently related to *Hyperammina friabilis* H. B. Brady.

Type.—Cat. No. 14741, U.S.N.M.

HYPERAMMINA SUBNODOSA H. B. Brady (?).

Hyperammina subnodosa H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 259, pl. 23, figs. 11-14.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 63, fig. 80 (in text).

There are three specimens of large size, the largest being 10 mm. in length and nearly 2.5 mm. in breadth. These have a coarse rough wall, composed of sand and sponge spicules and are constricted at intervals. The apertural end of the best preserved specimen has the opening covered in by sponge spicules, leaving small openings between. The form in general is tapering and they may represent this species, although they also resemble *H. friabilis* H. B. Brady.

Genus TOLYPAMMINA Rhumbler, 1895.

TOLYPAMMINA HORRIDA, new species.

Plate 74, fig. 5.

Description.—Test attached, under surface made up of a subglobular proloculum and elongate-cylindrical chamber; wall consisting of fine sponge spicules radiating from the surface; wall inside smoothly finished; aperture formed by the open end of the tube. This species resembles *Saccorhiza ramosa* H. B. Brady in the spicular character of the test, but is attached throughout its length, and has a subglobular proloculum, whereas typical *T. vagans* H. B. Brady has a smooth wall and elongate proloculum and is a much smaller species. The tubular portion of this species measures one-third mm. or more in diameter.

This seems to be a common species of the material. Four specimens are mounted and attached to shell fragments, all uniform in character. There is a specimen in Sidebottom's material[1] "almost white in color and attached to a fragment of a shell." This also may be the same as this species.

Type.—Cat. No. 14742, U.S.N.M.

Genus AMMOLAGENA Eimer and Fickert, 1899.

AMMOLAGENA CLAVATA (Parker and Jones).

Trochammina irregularis, var. *clavata* Parker and Jones, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 304.

Webbina clavata H. B. Brady, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 711; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 349, pl. 41, figs. 12–16.

Ammolagena clavata Eimer and Fickert, Zeitschr. wiss. Zool., vol. 65, 1899, p. 673.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 69, figs. 86–88.

There is a single specimen which may be referred to this species, but it is not typical. It consists of what seems to be a double-chambered proloculum with the tubular portion broken away.

Subfamily Ammodiscinae.

Genus AMMODISCUS Reuss, 1861.

AMMODISCUS MESTAYERI, new species.

Plate 74, figs. 1, 2.

Description.—Test large, in the microspheric form consisting of an elongate ovoid proloculum with three or four coils; central portion depressed; megalospheric form with large subglobular proloculum followed by one and one-half coils; test thickest in the central portion; wall composed of fine angular sand grains with whitish or light brown cement; exterior smoothly finished.

Diameter.—Microspheric, 4.5 mm.; megalospheric form, 2.5 mm. The proloculum of the megalospheric form is nearly 1 mm. in length, and of the microspheric about one-fourth that size.

[1] Journ. Roy. Micr. Soc., 1918, p. 11.

This is a peculiar species in the few coils of the test; especially in the megalospheric form, and with its very protuberant center it is nearly one-third again as wide in the center as in the outer portion. In the microspheric form the whole test is of even color except the border of each coil and the end of the last-formed coil, which are lighter colored. In the megalospheric form the proloculum and the beginning of the first coil are dark reddish brown. This does not seem at all like any of the other species of *Ammodiscus* that I have seen from any part of the world. It is probably a species limited to the Australian or Indo-Pacific region. Chapman[1] records *Ammodiscus tenuis* H. B. Brady, from his station off New Zealand, which may possibly be the same as this described here.

Type.—Cat. No. 14745, U.S.N.M.

Family LITUOLIDAE.

Subfamily REOPHACINAE.

Genus REOPHAX Montfort, 1808.

REOPHAX SPICULIFERA H. B. Brady.

Reophax spiculifera H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 54, pl. 4, figs. 10, 11; Rep. Voy. *Challenger*, Zoology vol. 9, 1884, p. 295, pl. 31, figs. 16, 17.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 92.

There are numerous specimens in the material which can be referred to this species. They are made entirely of elongate sponge spicules, very neatly cemented; occasionally the end of the spicules extends backward from the chamber, as in Brady's figure. The specimens, however, are much larger.

REOPHAX SPICULIFERA H. B. Brady, var. PSEUDODISTANS, new variety.

Plate 75, fig. 1.

Description.—Among the material are specimens in shape very close to *R. distans*, but the entire test is made up of sponge spicules and are evidently related to *R. spiculifera* H. B. Brady. The test is easily broken and numerous single chambers are found in the material.

Type.—Cat. No. 14743, U.S.N.M.

REOPHAX SCORPIURUS (?) Montfort.

Reophax scorpiurus MONTFORT, Conch. Syst., vol. 1, 1808, p. 330, 83me genre.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 291, pl. 30, figs. 12-17.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 83, figs. 114, and 116 (in text).

Some specimens in the material have the general form of this species as figured by Brady. They are made up of sponge spicules

[1] Trans. New Zealand Instit., vol. 38, 1905, p. 85.

and sand grains combined, and have a very irregular shape. It is a question if they really have anything to do with *R. scorpiurus*. Sidebottom records this[1]. His material is fragmentary, consisting of single chambers, and may possibly belong to the variety described here.

REOPHAX ADVENA, new species.

Plate 75, fig. 2.

Description.—Test elongate, thick; walls composed of very large, mostly clear, sand grains angularly cemented with a pale yellowish cement, in which are embedded very fine fragments; surface of the cement smooth and fragments of the test standing out as angular projections; chambers usually three or four, increasing gradually in size, the last formed one being the largest.

Length up to 5 mm.

This is apparently the same species that Sidebottom[2] had. He records this under the name *R. pilulifera* H. B. Brady, and gives the following notes: "Two fragments. The tests are much more roughly built-up than the *Challenger* specimens. The pale yellowish-cement used is plainly shown." This is somewhat like the large robust species which Pearcey has described from the Antarctic, but seems to be different from that species. In general form it is somewhat like *R. pilulifera* H. B. Brady, but is much larger and a more coarsely built species than that.

Type.—Cat. No. 14744, U.S.N.M.

Subfamily TROCHAMMININAE.

Genus HAPLOPHRAGMOIDES Cushman, 1910.

HAPLOPHRAGMOIDES GRANDIFORMIS Cushman.

Haplophragmoides grandiformis CUSHMAN, Proc. U. S. Nat. Mus., vol. 38, 1910, p. 440, fig. 11 (in text).

There are four specimens of smaller size than the type, but agreeing very well in general characteristics. The wall is composed of sand grains and yellowish-gray cement; on the whole rather neatly finished. Chapman[3] mentions specimens of *H. canariense* in which the texture is coarsely arenaceous and all of a ruddy brown color. These may be the same species.

HAPLOPHRAGMOIDES cf. ROTULATUM H. B. Brady.

A single specimen seems nearer to this species than any other described one.

[1] Journ. Roy. Micr. Soc., 1918, p. 13.
[2] Idem, p. 12.
[3] Trans. New Zealand Instit., vol. 38, 1905, p. 84.

Genus AMMOBACULITES Cushman, 1910.

AMMOBACULITES AGGLUTINANS (d'Orbigny).

Spirolina agglutinans d'Orbigny, Foram. Foss. Vienne, 1846, p. 137, pl. 7, figs. 10–12.

Haplophragmium agglutinans H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 301, pl. 32, figs. 19–26.

Ammobaculites agglutinans Cushman, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 115, fig. 176 (in text).

Five specimens seem to be referable to this species. They are not typical but are like the specimen figured on page 115,[1] the coiled portion not being very distinct from the later uncoiled portion. This same characteristic has been noted in the Philippine and other Pacific specimens, and they represent a different form from that described by d'Orbigny.

Genus TROCHAMMINA Parker and Jones, 1860.

TROCHAMMINA cf. NANA H. B. Brady.

There are three specimens in this material which are very close to this species as figured by Brady. The wall is very smooth, composed of an abundance of cement and scattered clear sand grains. Sidebottom[2] records this species.

TROCHAMMINA SQUAMATA Parker and Jones (?).

There are several specimens attached to shell fragments which are probably this species. The wall is made of sponge spicules, small angular quartz grains and fine, nearly white, cement. The surface is smoothly finished. Heron-Allen and Earland record this species from the Kerimba Archipelago, speaking of it as "nearly white in color." This is probably the same species as theirs from that region. Most of the specimens are surrounded by a considerable amount of amorphous material.

Genus AMMOSPHAEROIDINA Cushman, 1910.

AMMOSPHAEROIDINA SPHAEROIDINIFORMIS (H. B. Brady).

Haplophragmium sphaeroidiniformis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 313.

Ammosphaeroidina sphaeroidiniformis Cushman, Bull. 71, U. S. Nat. Mus., pt. 1, 1910, p. 128, fig. 202 (in text).

A single specimen, evidently this species, occurs among the mounted material.

[1] Bull. 71, U. S. Nat. Mus., pt. 1, 1910.

[2] Journ. Roy. Micr. Soc., 1918, p. 15.

Genus NOURIA Heron-Allen and Earland, 1913.

NOURIA POLYMORPHINOIDES Heron-Allen and Earland.

Plate 75, figs. 4, 5.

Nouria polymorphinoides Heron-Allen and Earland, Trans. Zool. Soc., London, vol. 20, 1915, p. 376, pl. 37, figs. 1–15, also p. 615.

Part of the original material described by Heron-Allen and Earland came from this same station, material having been sent them by Mr. Mestayer.

There are four specimens of this very interesting species in the mounted material which I have.

Family TEXTULARIIDAE.

Subfamily TEXTULARIINAE.

Genus TEXTULARIA Defrance, 1824.

TEXTULARIA SAGITTULA Defrance.

Textularia sagittula Defrance, Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 87.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 361, pl. 42, figs. 17, 18.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 5, figs. 2–5 (in text).

There are four specimens of the typical form of this species, very close to that figured by Brady [1]. These are elongate and increase but little in width as new chambers are added.

TEXTULARIA SAGITTULA Defrance, var. FISTULOSA H. B. Brady.

Textularia sagittula Defrance, var. *fistulosa* H. B. Brady, 1884, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 362, pl. 13, figs. 19-22.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 87, pl. 3, fig. 4.

There are five specimens apparently representing this variety described by Brady, mounted on the slide. Chapman records it from off Great Barrier Island, in 110 fathoms.

TEXTULARIA SAGITTULA Defrance, var. ATRATA Cushman.

Textularia sagittula Defrance, var. *atrata* Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 7, figs. 2–5 (in text).

There are three specimens which have the characters of this variety, which I described from the North Pacific. The sutures are covered with a dark-colored material, which forms a central band in addition.

TEXTULARIA RUGOSA (Reuss.)

Plecanium rugosum Reuss, Sitz. Akad. Wiss. Wien, vol. 59, 1869, p. 453, pl. 1, figs. 3*a–b*.

Textularia rugosa H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 363, pl. 42, figs. 23 and 24.

There are several specimens in different stages of growth, all of which probably belong to this species. None of them, however, are

[1] Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 42, fig. 17.

as well developed as the elongate specimen figured by Brady [1], which are so common in the Philippine region farther north. Neither Chapman nor Sidebottom record this species from this region.

TEXTULARIA STRICTA Cushman.

Textularia stricta CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 11, fig. 13 (in text).—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 20.

There are several specimens which are apparently the same as the species described from southern Japan. Sidebottom has recorded this species from his material from Australia, and has suggested that Chapman's material figured from Great Barrier Island, New Zealand, under the names *Spiroplecta sagittula* (Defrance), and *S. sagittula*, var. *fistulosa* Brady [2] is this same species. This material from New Zealand that I have had confirms this view. The largest specimens have between 30 and 40 chambers. The early portion suggests a spiroplectine condition, and although the other chambers can not be made out, the specimens are apparently microspheric.

TEXTULARIA GOËSII Cushman.

Textularia sagittula DEFRANCE, var. Goës, Köngl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, pl. 5, figs. 150–158.

Textularia trochus H. B. BRADY (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 366, pl. 43, fig. 17 (not 15, 16, 18, 19); pl. 44, figs. 1–3 (not *T. trochus* d'Orbigny).

Textularia goësii CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 15, fig. 24 (in text).

There are several specimens on the slide evidently belonging to this species. The largest of these is very close to the figure given by Brady [3] which he refers to *T. trochus* d'Orbigny. I have already called attention to the fact that this is not the same as D'Orbigny's species from the Cretaceous. This is apparently a species of the coral reef regions in the Indo-Pacific. Chapman records *T. trochus* from Great Barrier Island.

TEXTULARIA ABBREVIATA d'Orbigny.

Textularia abbreviata D'ORBIGNY, For. Foss. Vienne, 1846, p. 249, pl. 15, figs. 9–12 (7–12).—H. B. BRADY, PARKER, and JONES, Trans. Zool. Soc. London, vol. 12, 1888, p. 219, pl. 42, figs. 4, 5.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 14, fig. 20 (in text).

There are a few specimens evidently belonging to this species. They are somewhat like *T. conica*, but are much more compressed. Sidebottom records this species from the east coast of Australia.

[1] *Challenger Report*, pl. 42, fig. 24.
[2] Chapman, 1906, Trans. N. Zealand Instit., vol. 38, 1905, p. 87, pl. 3, fig. 4.
[3] *Challenger Report*, pl. 43, fig. 17.

TEXTULARIA APERTURALIS Cushman.

Textularia solita (Schwager), var. *inflata* Goës, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 42, pl. 5, figs. 1–3.

Textularia aperturalis Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 20, figs. 34–35.

There are several specimens which at first glance might be assigned to *T. concava* Karrer, but in the largest of these there is the characteristic inflated portion with high chambers and a divided aperture. The smaller, younger specimens have a simple aperture and they have developed only to the stage where the inflated condition is beginning to be apparent. If it were not for the only adult specimen they might be taken for *T. concava* var. *heterostoma* Fornasini. Sidebottom [1] records a single specimen which he refers to this variety. The type specimen of this species was from the west coast of America, recorded by Goës.

Genus BIGENERINA d'Orbigny, 1826.

BIGENERINA NODOSARIA d'Orbigny.

Bigenerina nodosaria d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 261, pl. 11, figs. 9–11.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 369, pl. 44, figs. 14–18.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 27, figs. 46–48 (in text).

There are two specimens of this typical coral reef species. Neither Chapman nor Sidebottom record this from this region.

Genus BOLIVINA d'Orbigny, 1839.

BOLIVINA DILATATA (?) Reuss.

There are several specimens which may be referred to this species, but they are not typical. One or two of them suggest *B. robusta* of Brady (especially *Challenger*, pl. 53, fig. 7). Others are more like *B. dilatata*. Chapman records *B. robusta* from off Great Barrier Island and mentions that these specimens are smaller than usual for this species.

BOLIVINA KARRERIANA H. B. Brady.

Bolivina karreriana H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 58; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 424, pl. 53, figs. 19–21.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 40, fig. 65 (in text).

There are on the slide seven very typical specimens. This species is recorded by Chapman from off Great Barrier Island, and Sidebottom, from the east coast of Australia. It is one of the characteristic species from the Indo-Pacific region.

[1] Journ. Roy. Micr. Soc., 1918, p. 20.

BOLIVINA NOBILIS Hantken.

Bolivina nobilis HANTKEN, Magy. kir. földt. int. évkönyve, vol. 4, 1875 (1876), p. 56, pl. 15, fig. 4; Mitth. Jahrb. Ung. geol. Anstalt, vol. 4, 1875 (1881), p. 65, pl. 15, fig. 4.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 424, pl. 53, figs. 14, 15.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 39, fig. 64 (in text).

There are two specimens that are evidently this species, although the recent material is referred by Brady to this species of Hantken from fossil beds of Hungary. It may be questionable whether this reference is correct. All the records for the recent occurrence of the species seem to be limited closely to the Indo-Pacific region, and it seems likely that the recent form is a valid species.

Genus VALVULINA d'Orbigny, 1826.

VALVULINA FUSCA (Williamson).

Rotalina fusca WILLIAMSON, Rec. Foram. Great Britain, 1858, p. 55, pl. 5, figs. 114, 115.

Valvulina fusca M. SARS, Vid. Selsk. Forh., 1868, p. 249.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 392, pl. 49, figs. 13, 14.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 59, figs. 94–95 (in text).

There is a single specimen which may be referred to this species. The chambers, however, are more inflated and distinct from one another, as characteristic of the species elsewhere. It may not belong here.

Genus GAUDRYINA d'Orbigny, 1839.

GAUDRYINA QUADRANGULARIS Bagg.

Gaudryina quadrangularis BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 133, pl. 5, fig. 1.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 64, fig. 103 (in text).

A single specimen seems very characteristic of this species described by Bagg from the Hawaiian Islands. It is very close to the specimen I have figured.[1]

GAUDRYINA TRIANGULARIS Cushman.

Gaudryina triangularis CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 65, figs. 103–104 (in text).

Numerous specimens are close to this species described from the Hawaiian Islands. They are perhaps more regular in form than the figured specimens, and are close to those given by Brady as *G. rugosa*.

Genus CLAVULINA d'Orbigny, 1826.

CLAVULINA cf. COMMUNIS d'Orbigny.

There are two specimens mounted which apparently may belong to this species. They are elongate, tapering, widest at the apertural end; the initial portion is somewhat angular and not in the

[1] Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 65, fig. 103.

same line as the later chambers. They are not closely like any of the figures given by Brady in the *Challenger* report.

CLAVULINA BRADYI Cushman.

Clavulina cylindrica H. B. Brady (not *C. cylindrica* d'Orbigny, 1826), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 396, pl. 48, figs. 32-38.
Clavulina soldanii Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 88.
Clavulina bradyi Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 73, figs. 118–119 (in text).

There are four specimens which are very evidently this species. Chapman records it from off Great Barrier Island, and our specimens show an exserted aperture very much like that shown by Brady in the *Challenger* report, but more strongly marked. The neck itself, however, has a definite labyrinthic opening, except for the smallest specimens, which are valvuline. I, however, do not think that all specimens referred to *Haplostiche soldanii* and *H. dubia* should belong to *Clavulina*, for in the Philippine region especially the two are very distinct. *Haplostiche* has no elongate aperture, and the labyrinthic opening is much more complex than in this species.

Subfamily Bulimininae.

Genus BULIMINA d'Orbigny, 1826.

BULIMINA OVATA d'Orbigny.

Bulimina ovata d'Orbigny, For. Foss. Vienne, 1846, p. 185, pl. 11, figs. 13, 14.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 400, pl. 50, figs. 13*a*, *b*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 77, fig. 125 (in text).

There are a few specimens of this species on the slide.

BULIMINA PYRULA d'Orbigny.

Bulimina pyrula d'Orbigny, For. Foss. Vienne, 1846, p. 184, pl. 11, figs. 9, 10.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 399, pl. 50, figs. 7–10.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 78, fig. 126 (in text).

Specimens like those figured by Brady occur in the material.

BULIMINA MARGINATA d'Orbigny.

Bulimina marginata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 269, No. 4, pl. 12, figs. 10–12.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 405, pl. 51, figs. 3–5.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 83, fig. 136 (in text).

This seems to be the most common species of the material, and the specimens are very characteristic for the most part. Some of them, however, have spines at the base which make them tend toward *B. aculeata* in this respect. No typical *aculeata* were found, however. Sidebottom records all three of these species, and Chapman records *B. pyrula* and *B. marginata;* the latter is abundant off Great Barrier Island.

Genus BULIMINELLA Cushman, 1911.

BULIMINELLA ELEGANTISSIMA d'Orbigny.

Buliminella elegantissima D'ORBIGNY, Foram. Amer. Merid., 1839, p. 51, pl. 7, figs. 13, 14.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 402, pl. 50, figs. 20–22.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, pt. 2, p. 122.

There are three specimens of this very definite species. Brady mentions in the *Challenger* report this species from Australia and the South Pacific and that it is widely scattered elsewhere. Chapman does not record it from Great Barrier Island, but Sidebottom records a single specimen from the east coast of Australia. All specimens are typical rather than like the variety described by Sidebottom.

Genus VIRGULINA d'Orbigny, 1826.

VIRGULINA SUBSQUAMOSA Egger.

Virgulina subsquamosa EGGER, Neues Jahrb., 1857, p. 295, pl. 12, figs. 19–21.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 415, pl. 52, figs. 9–11.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 92, figs. 145–146 (in text).

There are four specimens on the slide which are very close to the figures of this species given by Brady,[1] but not like the other figures given. It may be possible that Brady has several species under this one name. In the *Challenger* report Brady mentions that the finest specimens of this species occur amongst the islands of the Pacific, and it is quite probable that these specimens from New Zealand represent one of the species which Brady refers to. These range from Tahiti to the south coast of Japan, which is the range of so many of these species found in the Philippines, and southward to Australia.

Subfamily CASSIDULININAE.

Genus CASSIDULINA d'Orbigny, 1826.

CASSIDULINA SUBGLOBOSA H. B. Brady.

Cassidulina subglobosa H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 60; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 430, pl. 54, figs. 17, *a–c*.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 98, fig. 152 (in text).

Characteristic specimens of this species are on the slides. It is characteristic of deeper waters in most of the oceans, this being rather less than the usual depth for its occurrence. Both Chapman and Sidebottom record this species in their papers.

CASSIDULINA BRADYI Norman.

Cassidulina bradyi (Norman, MS.) WRIGHT, Proc. Belfast Nat. Field Club, App., 1880, p. 152.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 431, pl. 54, figs. 6–10.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 99, fig. 153 (in text).

There are several fine specimens which can be referred to this species. There seems, however, to be a distinction between the

[1] *Challenger* Report, pl. 52, fig. 9.

species found in the South Pacific and those in the North Atlantic. All these New Zealand specimens are much compressed, and, except that the adult ones are somewhat elongate, are of the type figured by Brady.[1] Sidebottom and Chapman both record this species, and it is possible that the compressed Pacific form should be distinguished from the more inflated Atlantic one.

Genus EHRENBERGINA Reuss, 1850.

EHRENBERGINA SERRATA Reuss, variety.

There are several mounted specimens in the collection which are uniform in character. They are much more compressed than is generally the case in this species, and the center portion where the angles of the sutures come together instead of being angled and projected is flattened. This is constant in all the specimens and may represent a distinct variety of the species. Sidebottom records this species from Australia, but makes no mention of any peculiarity of this sort.

Family LAGENIDAE.

Subfamily LAGENINAE.

Genus LAGENA Walker and Boys, 1784.

LAGENA GLOBOSA (Montagu).

Vermiculum globosum Montagu, Test. Brit., 1803, p. 523.

Lagena globosa Brown, Illus. Rec., Conch. Great Britain and Ireland, ed. 1, 1827, pl. 1, fig. 37.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 452, pl. 56, figs. 1–3.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 3, pl. 4, fig. 2.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 129.

There are several specimens of this common species, showing little variation except in the thickness of the test.

LAGENA LAEVIS (Montagu).

Vermiculum laeve Montagu, Test. Brit., 1803, p. 524.

Lagena laevis Williamson, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 12, pl. 1, figs. 1, 2.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 455.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 5, pl. 1, fig. 3; pl. 38, fig. 5.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 130.

A single specimen, nearly spherical in shape, evidently belongs here.

LAGENA LAEVIGATA (Reuss).

Fissurina laevigata Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 366, pl. 46, fig. 1.

Lagena laevigata Terrigi, Atti Accad. Pont. Nuovi Lincei, vol. 33, 1880,p. 177, pl. 1, fig. 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 473, pl. 114, figs. 8*a*, *b*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 7, pl. 2, fig. 1.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 130.

There are several specimens of this species, very close to the form which I have figured.[2]

[1] *Challenger* Report, pl. 54, fig. 10.

[2] Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 7, pl. 2, fig. 1.

LAGENA ELONGATA (Ehrenberg).

Miliola elongata EHRENBERG, Ber. preuss. Akad. Wiss. Berlin, 1844, p. 274; 1845, p. 371.

Lagena elongata TATE and BLAKE, Yorkshire Lias, 1876, p. 454, pl. 18, figs. 9, 9*a*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 457, pl. 56, fig. 29.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 91.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 12, pl. 1, fig. 5.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 130.

There are two specimens of this species, very elongate in form, and they have a definite phialine lip.

LAGENA APICULATA (Reuss).

Oolina apiculata REUSS, in Haidinger's Nat. Abhandl., vol. 4, 1850, p. 22, pl. 1, fig. 1.

Lagena apiculata REUSS, Sitz. Akad. Wiss. Wien, vol 46, 1862 (1863), p. 319, pl. 1, figs. 4–8, 10, 11.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 453, pl. 56. figs. 4, 15–18.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 13.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 129.

There are several specimens showing very little variation.

LAGENA HISPIDA Reuss.

Lagena hispida REUSS, Zeitschr. deutsch. geol. Ges., vol. 10, 1858, p. 43; Sitz. Akad. Wiss. Wien., vol. 46, 1863, p. 335, pl. 6, figs. 77–79.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 459, pl. 57, figs. 1–4.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 91.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 13, pl. 4, figs. 4, 5; pl. 5, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 130.

There are numerous specimens, all of one form, with a nearly spherical chamber; neck slender, exceeding the diameter of the test; somewhat similar to *Challenger* (pl. 57, fig. 2).

LAGENA SQUAMOSA (Montagu).

Vermiculum squamosum MONTAGU, Test. Brit., 1803, p. 526, pl. 14, fig. 2.

Lagena squamosa BROWN, Ill. Rec. Conch. Great Britain, 1827, pl. 1, fig. 32.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 471, pl. 58, figs. 28–31.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 16, pl. 6, fig. 1.

This species seems to be much more common than the following one, and can easily be distinguished from it by its ornamentation, even although of similar size.

LAGENA HEXAGONA (Williamson).

Entosolenia squamosa MONTAGU, var. *hexagona* WILLIAMSON, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 20, pl. 2, fig. 23.

Lagena hexagona SIDDALL, Cat. Brit. Rec. For., 1879, p. 6.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 472, pl. 58, figs. 32, 33.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 92.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 17, pl. 6, figs. 2, 3.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 130.

There are several specimens of very constant size and shape.

LAGENA STRIATA (d'Orbigny).

Oolina striata D'ORBIGNY, Foram. Amer. Merid., 1839, p. 21, pl. 5, fig. 12.
Lagena striata REUSS, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862, (1863) p. 327, pl. 3, figs. 44, 45; pl. 4, figs. 46, 47.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 460, pl. 57, figs. 22, 24.—CHAPMAN, Trans. New Zealand Instit., vol 38, 1905, p. 91.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 19, pl. 7, figs. 4, 5.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 130.

There are numerous specimens of the usual form, which has a spherical or slightly elongate body, with a conical tapering neck, sometimes with the striae continued out on to it, often in a spiral form. They are very common in the material.

LAGENA DESMOPHORA Rymer-Jones.

Lagena vulgaris WILLIAMSON, var. *desmophora* RYMER-JONES, Trans. Linn. Soc. London, vol. 30, 1872, p. 54, pl. 19, figs. 23, 24.
Lagena desmophora H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 468, pl. 58, figs. 42, 43.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 27, pl. 12, fig. 5; pl. 13, fig. 3.

There is a single specimen which apparently belongs to this species. It is very close to the specimen figured by Chapman,[1] as *L. quadralata* Brady. Rymer-Jones describes this species from off Java, and Sidebottom's records are from the southwest Pacific.

LAGENA SULCATA (Walker and Jacob).

Serpula (*Lagena*) *sulcata* WALKER and JACOB, Adams' Essays, Kanmacher's ed., 1798, p. 634, pl. 14, fig. 5.
Lagena sulcata PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 351.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 462, pl. 57, figs. 23, 26, 33, 34.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 91.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 22, pl. 9, fig. 2.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 130.

There are a few very typical specimens; the body spherical and the neck tapering conical, costae of the surface continued lengthwise on the neck.

LAGENA SULCATA (Walker and Jacob) var. APICULATA Cushman.

Lagena sulcata, apiculate forms, H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 58, figs. 4, 17 (?).—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 130.
Lagena sulcata (WALKER and JACOB) var. *apiculata* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 23, pl. 9, figs. 3, 4.

Numerous specimens occur with the apical end spinose, very similar to the type in Bulletin 71 (pt. 3, pl. 9, fig. 3).

[1] Journ. Linn. Soc. Zool., vol. 30, 1910, pl. 55, fig. 10.

LAGENA ACUTICOSTA Reuss.

Lagena acuticosta REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 1, 1861 (1862), p. 305, pl. 1, fig. 4.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 464, pl. 57, figs. 31, 32; pl. 58, figs. 20 (?), 21.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 23, pl. 8, figs 9, 10; pl. 23, fig. 2.

Two specimens occur which are very typical.

LAGENA SEMISTRIATA Williamson.

Lagena striata, var. *semistriata* WILLIAMSON, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1884, p. 14, pl. 1, figs. 9, 10.

Lagena semistriata JONES and PARKER, Monogr. Foram. Crag., 1866, p. 34, pl. 4, fig. 6.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 465, pl. 57, figs. 14, 16, 17.

There are six specimens of this species on the slide, very constant in their character, and close to *Challenger* (pl. 57, fig. 14).

LAGENA MARGINATA (Walker and Boys).

Serpula (*Lagena*) *marginata* WALKER and BOYS, Test. Min., 1784, p. 2, pl. 1, fig. 7.

Lagena marginata BROWN, Illus. Conch. Great Britain, 1827, pl. 1, figs. 30, 31.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 476, pl. 59, figs. 21–23.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 37, pl. 22, figs. 1–7.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 130.

There is a single specimen with a wide keel.

LAGENA ORBIGNYANA (Seguenza).

Entosolenia marginata WILLIAMSON (part) (not *L. marginata* (WALKER and BOYS)), Rec. Foram. Great Britain, 1858, p. 9, pl. 1, figs. 19, 20.

Fissurina orbignyana SEGUENZA, Foram. monotal. Mioc. Messina, 1862, p. 66, pl. 2, figs. 24, 26.

Lagena orbignyana H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 484, pl. 59, figs. 1, 18, 24, 26.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 42, pl. 19, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 131.

This occurs, as usual, in several forms. Two of the commoner forms are those figured by Sidebottom [1] and by Cushman.[2]

Subfamily NODOSARIINAE.

Genus NODOSARIA Lamarck, 1812.

NODOSARIA (GLANDULINA) LAEVIGATA d'Orbigny.

Nodosaria (*Glandulina*) *laevigata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 252, pl. 10, figs. 1–3.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 490, pl. 61, figs. 20–22.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 47, pl. 24, figs. 1, 2.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 131.

Several specimens occur and are very typical in all their characters.

[1] Journ. Quekett Micr. Club, vol. 12, 1913, pl. 17, fig. 10.

[2] Bull. 71, U. S. Nat. Mus., pt. 3, 1913, pl. 19, fig. 1.

NODOSARIA PYRULA d'Orbigny.

Nodosaria pyrula d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 253, No. 13.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 497, pl. 62, figs. 10–12.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 49, pl. 26, figs. 1–3.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 132.

There are several specimens of this species which show the proloculum of the form which I have figured.[1]

NODOSARIA PROXIMA Silvestri.

Nodosaria proxima Silvestri, Atti Accad. Gioenia, Catania, ser. 3, vol. 7, 1872, p. 63, pl. 6, figs. 138–147.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 511, pl. 64, fig. 15.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 52.

There are two specimens, each formed of two chambers, in general like those figured for this species, but with the costae more prominent than those figured by Brady. In general form and character, the specimens are close to those figured by Silvestri.

NODOSARIA RADICULA (Linnaeus).

Nautilus radicula Linnaeus, Syst. Nat., ed. 12, 1767, pp. 1164, 285.

Nodosaria radicula d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 252, No. 3.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 495, pl. 61, figs. 28–31.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 52.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 131, pl. 3, figs. 23–25.

A single specimen in the material is very close to this species, as figured by Brady, but lacks the apical spine.

NODOSARIA SOLUTA (Reuss).

Dentalina soluta Reuss, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 60, pl. 3, figs. 4*a*, *b*.

Nodosaria soluta Bornemann, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 322, pl. 12, fig. 12.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 503, pl. 62, figs. 13–16; pl. 64, fig. 28.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 93.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 53, pl. 26, figs. 9–11.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 133.

There are a few rather immature specimens which can be referred to this species, but they are not typical.

NODOSARIA COMMUNIS d'Orbigny.

Nodosaria (Dentalina) communis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 254, No. 35.

Dentalina communis d'Orbigny, Mém. Soc. Géol. France, vol. 4, 1840, p. 13, pl. 1, fig. 4.

Nodosaria communis Reuss, Verst. Böhm. Kreid., pt. 1, 1845, p. 28, pl. 12, fig. 21.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 504, pl. 62, figs. 19–22.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 54, pl. 28, figs. 1, 2.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 133.

Specimens comparable to those figured by Brady are not uncommon.

[1] Bull. 71, U. S. Nat. Mus., pt. 3, 1913, pl. 26, fig. 2.

NODOSARIA FILIFORMIS d'Orbigny.

Nodosaria filiformis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 253, No. 14.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 500, pl. 63, figs. 3–5.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 93, pl. 3, fig. 5.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 55, pl. 27, figs. 1–4.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 133.

One specimen, very close to that which I have figured,[1] occurs, but there are other specimens which show the proloculum similar to that of *N. pyrula*, but the chambers close set or oblique. These may be possibly microspheric and megalospheric forms of the same species, as the latter chambers are very similar.

NODOSARIA ROEMERI (Neugeboren).

Dentalina roemeri Neugeboren, Denkschr. Akad. Wiss. Wien, vol. 12, 1856, p. 82, pl. 2, figs. 13–17.

Nodosaria roemeri Reuss, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 475.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 505, pl. 63, fig. 1.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 94.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 55, pl. 24, figs. 4–6.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 134.

Very typical specimens occur, similar to that figured by Brady.

NODOSARIA CONSOBRINA (d'Orbigny), var. EMACIATA (Reuss).

Dentalina emaciata Reuss, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 63, pl. 3, fig. 9.

Nodosaria (*D.*) *consobrina*, var. *emaciata* Reuss, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 132, pl. 2, figs. 12, 13.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 502, pl. 62, figs. 25, 26.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 93.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 56, pl. 27, fig. 9.

Numerous specimens occur, similar to those figured in the *Challenger* report.

NODOSARIA MUCRONATA (Neugeboren).

Nodosaria (*Dentalina*) *obliqua* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 254, No. 36.

Dentalina mucronata Neugeboren, Denkschr. Akad. Wiss. Wien, vol. 12, 1856, p. 83, pl. 3, figs. 8–11.

Nodosaria mucronata Reuss, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 475, No. 30.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 506, pl. 62, figs. 27–31.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 56, pl. 24, fig. 3; pl. 25, fig. 2; pl. 27, figs. 5–7; pl. 35, fig. 6.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 134.

There are several specimens evidently this species, with both apical and apertural ends acute, and the chambers overlapping to form the smooth surface.

[1] Bull. 71, U. S. Nat. Mus., pt. 3, 1913, pl. 27, figs. 1–2.

NODOSARIA SCALARIS (Batsch).

Nautilus (*Orthoceras*) *scalaris* Batsch, Conch. des Seesandes, 1791, No. 4, pl. 2, figs. 4*a*, *b*.

Nodosaria scalaris Parker and Jones, Philos. Trans., vol. 155, 1865, p. 340, pl. 16, figs. 2*a*, *b*, *c*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 510, pl. 63, figs. 28–31.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 58, pl. 24, fig. 7.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 134.

Two forms occur—one with the apical spine as figured by Brady [1] the other with the apical spine wanting, and a the costae of the surface extending over the apical end. These have the appearance of a test in which the first chamber has in some way become detached.

NODOSARIA VERTEBRALIS (Batsch).

Nautilus (*Orthoceras*) *vertebralis* Batsch, Conch. des Seesandes, 1791, p. 3, No. 6, pl. 2, fig. 6*a*, *b*.

Nodosaria vertebralis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 514, pl. 63, fig. 35; pl. 64, figs. 11–14.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 60, pl. 32, fig. 1.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 134.

Nodosaria obliqua Linnaeus, var. *vertebralis* Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 94, pl. 3, fig. 5.

This species seems to attain a large size in this material and may be compared to that found in the Philippine region.

NODOSARIA HIRSUTA d'Orbigny.

Nodosaria hirsuta d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 252, No. 7.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 60, pl. 28, fig. 3.

Nodosaria hispida d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 35, pl. 1, figs. 24, 25.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 507, pl. 63, figs. 12–16.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 135.

There is a single specimen mounted which is very close in its character to that figured by Brady (*Challenger*, pl. 63, fig. 14).

Genus LINGULINA d'Orbigny, 1826.

LINGULINA CARINATA d'Orbigny (?).

Lingulina carinata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 257, No. 1.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 517, pl. 65, fig.(?)16.

There is a single specimen which is almost identical in all its characters with that figured by Brady [2] under this name. This is, however, evidently not *L. carinata* d'Orbigny. Brady mentions in his list of localities that he had material from the South Pacific, and this form figured by him may possibly be characteristic of this region. It is evidently a new species or variety, which should be described when more material is available.

[1] *Challenger* Report, pl. 63, figs. 28–31.

[2] *Challenger* Report, pl. 65, fig. 16.

LINGULINA GRANDIS Cushman.

Lingulina grandis CUSHMAN, Proc. U. S. Nat. Mus., vol. 51, 1917, p. 656.

There is a single specimen which is undoubtedly the same species which I described from the Philippines. This specimen is not as large as the type: it is between 3 and 4 mm. in length, and 1.2 mm. in width. This is another species which connects the foraminifere fauna of the Philippine region with that of New Zealand and Australia.

Genus CRISTELLARIA Lamarck, 1812.

CRISTELLARIA CULTRATA (Montfort).

Robulus cultratus MONTFORT, (?) Conch. Syst., vol. 1, 1808, p. 214, 54e genre.
Robulina cultrata D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 287, No. 1.
Cristellaria cultrata PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 344, pls. 13, 17, 18; pl. 16, fig. 5.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 550, pl. 70, figs. 4, 5, 6.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 98.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 64, pl. 29, fig. 4.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 142.

Very typical material occurs, both adult and young specimens.

CRISTELLARIA ARTICULATA Reuss.

Robulina articulata REUSS, Sitz. Akad. Wiss. Wien, vol. 48, 1863, p. 53, pl. 5, fig. 62.
Cristellaria articulata REUSS, Sitz. Akad. Wiss. Wien, vol. 62, 1870, p. 483.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 547, pl. 69, figs. 10–12.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 97.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 65, pl. 31, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 141.

A few specimens with the characteristic apertural characters occur. They are close to the specimens figured by Brady,[1] but with the keel much more pronounced. In the general form of the chambers and keel they are somewhat similar to the figure of *C. nitida* as figured by Brady,[2] except in the apertural characters.

There is one specimen mounted on a separate slide from the others, which is one of the wild-growing forms mentioned and figured by Brady and is very similar to *Challenger*.[3] Sidebottom[4] had one specimen of this same form. From a comparison of the *Challenger* figures with the typical material, it is difficult to see what the two forms have in common. Our specimen is certainly like Brady's figure referred to, but is very unlike the typical specimens found in this same material.

CRISTELLARIA ROTULATA (Lamarck).

Lenticulites rotulata LAMARCK, Ann. Mus., vol. 5, 1804, p. 188, No. 3.
Cristellaria rotulata D'ORBIGNY, Mém. Soc. Géol. France, ser. 1, vol. 4, 1840, p. 26, pl. 2, figs. 16-18.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9,

[1] *Challenger* Report, pl. 69, figs. 11–12.
[2] Idem, pl. 70, fig. 2.
[3] Idem, pl. 69, fig. 2.
[4] Journ. Roy. Micr. Soc., 1918, p. 141.

1884, p. 547, pl. 69, figs. 13*a*, *b*.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 97.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 66, pl. 35, fig. 3.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 142.

There are a very few typical specimens of this species representing both adult and early stages.

CRISTELLARIA ORBICULARIS (d'Orbigny).

Robulina orbicularis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 288, pl. 15, figs. 8–9.

Cristellaria orbicularis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 549, pl. 69, fig. 17.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 97.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 67, pl. 36, figs. 4, 5.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 142.

There are characteristic specimens both of the young and the adult.

CRISTELLARIA GIBBA d'Orbigny.

Cristellaria gibba d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminiféres," p. 63, pl. 7, figs. 20, 21.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 546, pl. 69, figs. 8, 9.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 69, pl. 35, fig. 1.

Material very close to that figured by Brady [1] occurs.

CRISTELLARIA VARIABILIS Reuss.

Cristellaria variabilis Reuss, Denschr. Akad. Wiss. Wien, vol. 1, 1849, p. 369, pl. 46, figs. 15, 16.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 541, pl. 68, figs. 11–16.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 70, pl. 36, figs. 1–3.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 141, pl. 5, fig. 8.

There are numerous excellent specimens of this species.

CRISTELLARIA CREPIDULA (Fichtel and Moll).

Nautilus crepidula Fichtel and Moll, Test. Micr., 1803, p. 107, pl. 19, figs. *g–i*.

Cristellaria crepidula d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839. "Foraminiféres," p. 64, pl. 8, figs. 17–18.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 542, pl. 67, figs. 17, 19, 20; pl. 68, figs. 1–2.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 70, pl. 29, figs. 5, 6; pl. 31, figs. 2–5.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 140.

As usual, there is a considerable variation of the specimens representing this species, but all are typical in their general character. The variation is largely in length and the extent to which the chambers continue back on the ventral side.

CTRISTELLARIA TRICARINELLA Reuss.

Cristellaria tricarinella Reuss, Sitz. Akad Wiss. Wien, vol. 46, 1862, p. 68, pl. 7, fig. 9; pl. 12, figs. 2–4.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 540, pl. 68, figs. 3, 4.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 96.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 72, pl. 34, figs. 1, 2.

This species seems to be one of the most common in the material, as far as the mounted specimens show. They are very typical.

[1] *Challenger* Report, pl. 69, figs. 8–9.

Brady's *Challenger* records are from the Philippines, 95 fathoms; off Raine Island, Torres Strait, 155 fathoms, and off the west coast of New Zealand, 150 fathoms. I have had this species from off Japan, and it is evidently a species of the Indo-Pacific region. It may possibly be that it is not the same as the fossil species described by Reuss from the Cretaceous of Germany.

CRISTELLARIA TRICARINELLA Reuss, var. SPINIPES Cushman.

Cristellaria tricarinella REUSS, var. *spinipes* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 72, pl. 33, fig. 2.

I described this variety from off Japan. That material differed from the typical *C. tricarinella* only in the addition of a large spine at the apical end of the test and with more limbate sutures. This material from New Zealand, while in general appearance like that of *C. tricarinella*, has several spines at the apical end; but the main difference is that the early portion is completely involute and quite different in appearance from that from Japan. The early stages are not at all like that of the numerous specimens of *C. tricarinella* which are mounted on the slide. It is an interesting form and may prove to be distinct.

CRISTELLARIA DENTICULIFERA Cushman.

Cristellaria cultrata H. B. BRADY (part) (not *C. cultrata* Montfort), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 550, pl. 70, figs. 7, 8.
Cristellaria denticulifera CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 75, pl. 37, fig. 1.

There is a single large specimen which is very close to this species as figured by Brady. The walls of the chambers are ornamented with longitudinal curved costae, and the denticulate borders with the raised sutures show it to be this species. The number of chambers is also similar to that in the figured specimen. The material I have had is from off Japan, but Brady's material is indefinite as to locality.

CRISTELLARIA SCHLOENBACHI Reuss.

Cristellaria schloenbachi REUSS, Sitz. Akad. Wiss. Wien, vol. 46, 1862, p. 65, pl. 6, figs. 14, 15.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 539, pl. 67, fig. 7.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 96.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 77, pl. 36, fig. 6.

Brady figures a single specimen which he refers to this species.[1] It is very close to this material. His records for this species include one station from this general region, off Raine Island, 155 fathoms. Chapman records a single specimen from off New Zealand.[2] It is also recorded by Millett from the Malay Archipelago. I have had it in some numbers from the Philippines. In the North Pacific

[1] *Challenger* Report, pl. 67, fig. 7.

[2] Trans. New Zealand Inst., vol. 38, 1905, p. 96.

material which I had it occurred as far north as Korea Strait, showing that it has a wide distribution in the Indo-Pacific region. This should be closely compared with the material from the Atlantic.

CRISTERLLARIA LATIFRONS H. B. Brady.

Cristellaria latifrons H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 544, pl. 68, fig. 19; pl. 113, figs. 11*a*, *b*.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 97.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 78, pl. 38, fig. 2.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 140.

Brady described this species from two widely separated regions—one off Culebra Island, West Indies, and the other from off New Zealand. This material from "Poor Knights Islands" is of the form figured by Brady.[1]

Flint's specimens from the Gulf of Mexico do not seem to be as typical as these from New Zealand, and it is to be suspected that Brady's figure is that from his New Zealand locality. It may be that the two regions have distinct forms. It occurs in typical form in the Philippines, recorded by Sidebottom, and I have material in the *Albatross* and Philippine dredgings, so it is evidently a rather widespread species, at least in the Indo-Pacific regions.

CRISTELLARIA ITALICA (Defrance) (?).

Saracenaria italica Defrance, Dict. Sci. Nat., vol. 32, 1824, p. 177, vol. 47, 1827, p. 344.

Cristellaria (*Saracenaria*) *italica* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 293, No. 26.

Cristellaria italica Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, pp. 21, 32, pl. 1, figs. 41, 42.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 544, pl. 68, figs. 17, 18, 20-23.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 78, pl. 33, fig. 3.

There is a species which seems to be common, which is much broader than *C. latifrons*, and yet is not the typical form of *C. italica*. The ventral base of the chamber in the adult is broadly triangular, much like that of *C. italica*, but it extends nearly to the base of the test. This is a form placed by some writers under *C. acutauricularis*.

Genus MARGINULINA d'Orbigny, 1826.

MARGINULINA GLABRA d'Orbigny.

Marginulina glabra d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 259, No. 6.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 527, pl. 65, figs. 5, 6.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 95.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 79, pl. 23, fig. 3.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 138, pl. 4, figs. 26-31; pl. 5, figs. 1-3.

There are several typical specimens of this species.

[1] *Challenger* Report, pl. 68, fig. 19.

Genus VAGINULINA d'Orbigny, 1826.

VAGINULINA LEGUMEN (Linnaeus).

Nautilus legumen LINNAEUS, Syst. Nat., ed. 10, 1758, p. 711, No. 248.
Vaginulina legumen D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 257, No. 2.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 530, pl. 66, figs. 13–15.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 80, pl. 39, fig. 4.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 139.

This seems to be a common species from the number of mounted specimens. They are close to the figures given by Brady for this species.

Genus FRONDICULARIA Defrance, 1824.

FRONDICULARIA COMPTA H. B. Brady.

Frondicularia compta H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 57, pl. 8, fig. 6; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 520, pl. 65, fig. 19.

Brady figures and describes a very peculiar specimen under this species name. It came from off East Moncoeur Island, Bass Strait, depth 38 fathoms. He also figures [1] a specimen from off Raine Island which he refers to *F. archiaciana* d'Orbigny. In this material from New Zealand there are four specimens which should be referred to either one or the other of these figures given by Brady. These have from three to five chambers. One of them has somewhat the ornamentation shown in plate 114, figure 12. The others are more like the earlier chambers of *F. compta*, plate 65, figure 19. It seems quite likely that both the specimens which Brady had may be one species, in which case they probably should both be placed under Brady's species. At any rate the New Zealand specimens which are in this collection seem to belong to *F. compta*, which is evidently a very rare species, and should be looked for elsewhere in the Indo-Pacific region.

Subfamily POLYMORPHININAE.

Genus POLYMORPHINA d'Orbigny, 1826.

POLYMORPHINA GIBBA d'Orbigny.

Polymorphia (Globulina) gibba D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 226, No. 20.
Polymorphina gibba H. B. BRADY, PARKER, and JONES (part), Trans. Linn. Soc. London, vol. 27, 1870, p. 216, pl. 39, figs. 2*a–d*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 561, pl. 71, figs. 12*a*, *b*.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 85, pl. 41, fig. 4.

Both the typical form and two specimens of the fistulose form occur on the slides. They are very close to the figures given by Brady.

[1] *Challenger* Report, pl. 114, fig. 12.

POLYMORPHINA OBLONGA d'Orbigny.

Polymorphina oblonga d'Orbigny, For. Foss. Vienne, 1846, p. 232, pl. 12, figs. 29–31.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 569, pl. 73, figs. 2–4.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 88, pl. 37, fig. 6.

The specimens on the slide are very similar to the specimens figured by Brady.[1]

POLYMORPHINA ELEGANTISSIMA Parker and Jones.

Polymorphina elegantissima Parker and Jones, Philos. Trans., vol. 155, 1865, p. 438.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 566, pl. 72, figs. 12–15.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 90, pl. 38, fig. 1.

There are two specimens on the slide which are evidently the young of this species, which is common in shallow water in the entire Indo-Pacific region.

POLYMORPHINA PROBLEMA d'Orbigny.

Polymorphina problema d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 266, No. 14.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 568, pl. 72, fig. 20; pl. 73, fig. 1.

There are numerous specimens in all stages, some of which are close to Brady's figure,[2] but the adults are, as a rule, broader than those specimens. Otherwise they are typical.

POLYMORPHINA REGINA H. B. Brady, Parker, and Jones.

Polymorphina regina H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, vol. 27, 1870, p. 241, pl. 41, figs. 32*a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 571, pl. 73, figs. 11–13.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 91, pl. 41, figs. 6, 7.

There are two small specimens with the characteristic ornamentation of this species.

Subfamily Uvigerininae.

Genus UVIGERINA d'Orbigny, 1826.

UVIGERINA PYGMAEA d'Orbigny.

Uvigerina pigmea d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 269, pl. 12, figs. 8, 9.
Uvigerina pygmaea d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 190, pl. 11, figs. 25, 26.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 575, pl. 74, figs. 11–14.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 99.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 96, pl. 42, fig. 1; pl. 44, fig. 5.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 146.

A few specimens may be referred to this common species.

[1] *Challenger* Report, pl. 73, fig. 2.

[2] Idem, pl. 73, fig. 1.

UVIGERINA AMPULLACEA H. B. Brady.

Uvigerina asperula CZJZEK, var. *ampullacea* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 579, pl. 75, figs. 10, 11.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 146.

Uvigerina ampullacea EGGER, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 313, pl. 9, fig. 37.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 102, pl. 42, fig. 3.

A few specimens may be referred to this species, having the characteristic form of the last chambers.

UVIGERINA INTERRUPTA H. B. Brady.

Uvigerina interrupta H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 60, pl. 8, figs. 17, 18; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 580, pl. 75, figs. 12–14.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 103, pl. 44, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 147.

There are a few specimens of this species which are very similar to those figured by Brady.[1] It is evidently a species occurring in the Indo-Pacific region in shallow water. Brady's material is all from the South Pacific. Chapman records it from the Arabian Sea, and it is known as far east as off the Galapagos, and Juan Fernandez. Most of the records are in comparatively shallow water.

Genus SIPHOGENERINA Schlumberger, 1883.

SIPHOGENERINA BIFRONS, var. STRIATULA Cushman.

Siphogenerina bifrons, var. *striatula* CUSHMAN, Proc. U. S. Nat. Mus., vol. 51, 1917, p. 662.

There is a single specimen of this variety in the material. It is common in the Philippine region and extends its range very much to the south, showing that it is probably widely distributed in the Indo-Pacific.

Subfamily RAMULININAE.

Genus RAMULINA Rupert-Jones, 1875.

RAMULINA GLOBULIFERA H. B. Brady.

Ramulina globulifera H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 58, pl. 8, figs. 32, 33; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 587, pl. 76, figs. 22–28.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 99.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 3, p. 110, pl. 39, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 149.

There are one or two specimens which probably belong to this species, although they may be possibly very fistulose *Polymorphinae*. Both specimens, however, have a definite chamber, from which branch the numerous arms. Therefore they seem to be reasonably placed under *Ramulina*.

[1] *Challenger* Report, pl. 75, figs. 12–14.

Family CHILOSTOMELLIDAE.

Genus CHILOSTOMELLA Reuss, 1850.

CHILOSTOMELLA OVOIDEA Reuss.

Chilostomella ovoidea Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 380, pl. 48, fig. 12.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 436, pl. 55, figs. 12–23.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 2, pl. 1, figs. 1–5.

There are several specimens mounted on the slide which seem to show possibly both microspheric and megalospheric forms. There are two very distinct sizes: the larger specimen is evidently somewhat like *C. grandis* Cushman, described from the Philippines. It is however not as large as that species.

Family GLOBIGERINIDAE.

Genus GLOBIGERINA d'Orbigny, 1826.

GLOBIGERINA BULLOIDES d'Orbigny.

Globigerina bulloides d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 277, No. 1.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 593, pl. 77; pl. 79, figs. 3–7.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 100.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 5, pl. 2, figs. 7–9; pl. 9.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 149.

This seems to be a common species in the material from the number of specimens mounted.

GLOBIGERINA DUBIA Egger.

Globigerina dubia Egger, Neues Jahrb. für Min., 1857, p. 281, pl. 9, figs. 7–9.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 595, pl. 79, figs. 17*a–c*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 6, pl. 4, figs. 1–3.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 149.

This form seems to be common from the number of specimens mounted. Chapman, however, does not record it in his material from New Zealand.

GLOBIGERINA RUBRA d'Orbigny.

Globigerina rubra d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, Foraminiféres, p. 94, pl. 4, figs. 12–14.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 602, pl. 79, figs. 11–16.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 9, pl. 3, figs. 6–9.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 149.

There are but two specimens of this species. These have the characteristic form but not the color. Sidebottom's specimens show no color. This seems to be true of most specimens from the Indo-Pacific region. Very few have the red color characteristic of Atlantic specimens. Chapman does not record it from New Zealand.

GLOBIGERINA CONGLOBATA H. B. Brady.

Globigerina conglobata H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 72; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 603, pl. 80, figs. 1–5; pl. 82, fig. 5.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 10, pl. 3, figs. 3–5; pl. 10. figs. 1, 6.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 150.

There are numerous specimens of small size and fairly characteristic, but not as fully developed as those from other regions. Chapman does not record this from New Zealand, but Sidebottom mentions "fine specimens."

GLOBIGERINA SACCULIFERA H. B. Brady.

Globigerina helicina Carpenter (not *G. helicina* d'Orbigny), Intr. Foram., 1862, pl. 12, fig. 11.

Globigerina sacculifera H. B. Brady, Geol. Mag., dec. 2, vol. 4, 1877, p. 535; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 604, pl. 80, figs. 11–17; pl. 82, fig. 4.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 11, pl. 2, figs. 4–6; pl. 5; pl. 10, fig. 4.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 149.

Numerous typical specimens occur. Sidebottom also had the species, but Chapman did not.

GLOBIGERINA AEQUILATERALIS H. B. Brady var. INVOLUTA Cushman.

Globigerina aequilateralis H. B. Brady, var. *involuta* Cushman, Proc. U. S. Nat. Mus., vol. 51, 1917, p. 662.

All the specimens which can be referred to this species in this material are of the form described from the Philippines. In this the last-formed coil overlaps and largely covers the earlier portion. Both Chapman and Sidebottom record this species from this region.

Genus ORBULINA d'Orbigny, 1839.

ORBULINA UNIVERSA d'Orbigny.

Orbulina universa d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminiféres," p. 3, pl. 1, fig. 1.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 608, pl. 78; pl. 81, figs. 8–26; pl. 82, figs. 1–3.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 101.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 14, pl. 6; pl. 7; pl. 11, fig. 3.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 151.

There are a few mounted specimens, hardly any of which are typical. Most of them have two visible chambers, and some more than two, evidently young stages in the development of the species. It may be that these were mounted especially on account of their interest and the typical material common, but not mounted.

Genus SPHAEROIDINA d'Orbigny, 1826.

SPHAEROIDINA BULLOIDES d'Orbigny.

Sphaeroidina bulloides d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 267, No. 1.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 620, pl. 84, figs. 1–7.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 101.—Cushman,

Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 18, pl. 10, fig. 7; pl. 12, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 151.

There are numerous specimens of this species, which is recorded by Chapman and Sidebottom as rare.

SPHAEROIDINA DEHISCENS Parker and Jones.

Sphaeroidina dehiscens PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 369, pl. 19, fig. 5, *a*, *b*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 621, pl. 84, figs. 8–11.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 19, pl. 10, fig. 2; pl. 13, fig. 1.

A few specimens evidently young of this species occur, but no well-developed ones. Chapman does not record it, and Sidebottom quotes it as "rare, but typical."

Genus PULLENIA Parker and Jones, 1862.

PULLENIA QUINQUELOBA (Reuss).

Nonionina quinqueloba REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 47, pl. 5, figs. 31*a*, *b*.

Pullenia quinqueloba H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 617, pl. 84, figs. 14, 15.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 101.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 21, pl. 13, fig. 2.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 151.

Very typical specimens occur which are characteristic in every way; they are well-developed adult specimens. Brady records this from the east coast of New Zealand, and Chapman and Sidebottom both record it. Sidebottom mentions that his specimens varied in the number of chambers and final whorl, there being from four to seven chambers. Our specimens have the characteristic five visible chambers.

PULLENIA OBLIQUILOCULATA Parker and Jones.

Pullenia obliquiloculata PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 368, pl. 19, figs. 4*a*, *b*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 618, pl. 84, figs. 16–20.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 22, pl. 10, fig. 3; pl. 12, figs. 2, 3.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 151.

This is the commonest species of this group and is typical in form and of full size. Sidebottom had the species from the east coast of Australia.

Family ROTALIIDAE.

Subfamily SPIRILLININAE.

Genus SPIRILLINA Ehrenberg, 1841.

SPIRILLINA VIVIPARA Ehrenberg.

Spirillina vivipara EHRENBERG, Abh. Akad. Wiss. Berlin, 1841, p. 442, pl. 3, fig. 41.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 630,

pl. 85, figs. 1–5.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 3, pl. 1, figs. 1, 2.—SIDEBOTTOM, Journ. Roy. Micr., Soc., 1918, p. 250.

There are five specimens on the slide, all of the same form and general characters. The test is very thin and transparent, and prominently, but finely perforate. The keels are more or less irregular, occasionally somewhat angled in places.

SPIRILLINA DECORATA H. B. Brady.

Spirillina decorata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 633, pl. 85, figs. 22–25.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 7, pl. 5, figs. 1, 2.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 250.

There is a single specimen which is evidently this species. It, however, agrees with the two smaller tests mentioned by Sidebottom, resembling *S. limbata* var. *denticulata.*

SPIRILLINA LIMBATA H. B. Brady, var. DENTICULATA H. B. Brady.

Spirillina limbata H. B. BRADY, var. *denticulata* H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 632, pl. 85, fig. 17.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 5, pl. 3, figs. 1, 2.

There are two specimens very clearly this species. They are mounted with the typical form. Both of these specimens are broadest on the ventral side which is acutely angled.

Subfamily ROTALINAE.

Genus DISCORBIS Lamarck, 1804.

DISCORBIS TURBO (d'Orbigny).

Rotalia (*Trochulina*) *turbo* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 274, No. 39; Modéles, No. 73.

Discorbina turbo CARPENTER, PARKER, and JONES, Introd. Foram., 1862, p. 200.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 642, pl. 87, figs. 8*a–c*.

Discorbis turbo CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 10, pl. 11, fig. 2.

A single very typical specimen is mounted. This species is not mentioned either by Chapman or Sidebottom, but was dredged by the *Challenger* off Australia in shallow water. I had the species from the Hawaiian Islands and Japan, showing that it has a wide range in this faunal area.

DISCORBIS ROSACEA (d'Orbigny).

Rotalia rosacea D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 273, No. 15.

Discorbina rosacea H. B. BRADY, Trans. Linn. Soc., vol. 24, 1864, p. 473, No. 69; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 644, pl. 87, figs. 1, 4.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 252.

Discorbis rosacea CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 13, fig. 13, (in text).

There are two sets of specimens mounted, one of which evidently represents dead shells without color; the other, live ones in which

the central chambers are the characteristic reddish brown. In form these are very similar to the specimens figured by Brady.[1]

DISCORBIS VILARDEBOANA (d'Orbigny) (?).

There is a specimen which is very close to that figured by Brady under this name.[2] This is referred by Heron-Allen and Earland in their Clare Island Paper to *D. concinna* Brady. However, comparison of these two in the *Challenger* plates show that there are differences between them, which this specimen bears out. It is evidently not *D. vilardeboana* d'Orbigny. A similar form to this occurs in the Philippines and appears to be a definite species occurring in the Indo-Pacific region.

DISCORBIS PATELLIFORMIS (H. B. Brady).

Discorbina patelliformis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 647, pl. 88, figs. 3*a–c*; pl. 89, figs. 1*a–c*.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 254.

Discorbis patelliformis Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 17, pl. 5, fig. 5; fig. 19 (in text).

One very typical specimen is mounted. This seems to be a species known largely from the South Pacific. It is recorded as far north as Laysan Island by Rhumbler, and the Malay Archipelago by Millett, and as far west as Madagascar. There are records for it in the Mediterranean. It seems to occur mostly in comparatively shallow water.

DISCORBIS BERTHELOTI (d'Orbigny).

Rosalina bertheloti d'Orbigny, in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, vol. 2, pt. 2, 1839, "Foraminiféres," p. 135, pl. 1, figs. 28–30.

Discorbina bertheloti H. B. Brady, Trans. Linn. Soc. London, vol. 24, 1864, p. 469, pl. 48, figs. 10*a*, *b*; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 650, pl. 89, figs. 10–12.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 253.

Discorbis bertheloti Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 20, pl. 7, fig. 3; fig. 23 (in text).

This seems to have been a common species from the material, as a large set is mounted. They are very typical.

DISCORBIS RARESCENS (H. B. Brady).

Discorbina rarescens H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 651, pl. 90, figs. 2, 3, and 4.—Chapman, Journ. Quekett Micr. Club, ser. 2, vol. 10, 1907, p. 136.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 253.

Discorbis rarescens Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 20, pl. 7, fig. 4; fig. 24 (in text).

There is a single specimen of this species with four visible chambers, and a thin narrow keel surrounding the entire test. It was described by Brady from off Raine Island and from the Philippines. Sidebottom had a few specimens from off Australia.

[1] *Challenger* Report, pl. 87, fig. 1.

[2] Idem, pl. 86, fig. 12.

DISCORBIS PILEOLUS (d'Orbigny.)

Valvulina pileolus D'ORBIGNY, Foram. Amer. Merid., 1839, p. 47, pl. 1, figs. 15–17.
Discorbina pileolus PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 385.

There are very numerous specimens of this species, most of which are plastogamic—a condition which appears to be common in this species. Most of the records for this species seem to be from the Indian and South Pacific Oceans. There is one specimen which has a border with a row of short spines which suggests a varietal character, but no name is given it as only one specimen occurs.

DISCORBIS BICONCAVA (Parker and Jones.)

Discorbina biconcava PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 422, pl. 19, fig. 10.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 653.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 255.

There are six specimens on one of the slides, which agree very closely with the *Challenger* figures. Almost all the records for this species are about Australia, except one from Siddall, from Great Britain. This is recorded as a very small form, and it may be questionable as to its really being identical with this species, especially since Sidebottom records a single small specimen from off Australia. Heron-Allen and Earland in their Clare Island Paper do not record this species.

DISCORBIS INCONSPICUA (H. B. Brady).

Textularia inconspicua H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 357, pl. 42, figs. *6a–c*.—MILLETT, Journ. Roy. Micr. Soc., 1899, p. 557, pl. 7, fig. 1.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 86.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 18.—HERON-ALLEN and EARLAND, Trans. Zool. Soc., vol. 20, 1915, p. 623, pl. 47, figs. 1–4.

In the material from this station there are six specimens of this species. These show the early chambers to be spiral; the walls are very thin and translucent, and distinctly perforated. Millett has already remarked that this species has certain characteristics, making it more like some of the Rotaliidae than the other species of *Textularia*, and Brady also observed this same resemblance. I have already noted (pt. 2, p. 19) that it might belong to *Discorbis*, but that "a study of the apical characters and the arrangement of the early chambers should determine this." This material now can be used for this study, and seems to determine definitely that it should be placed among the Rotaliidae. In some of its markings it resembles *Patellina*, and is here placed under *Discorbis*. It seems to be a species in which the chambers each make a half coil as added, and its resemblance to *Textularia* is only superficial. This seems to be clearly an Indo-Pacific species. The localities given by Brady are off Moncoeur Island, Bass Strait, 38 fathoms; Nares Harbor, Admi-

ralty Islands, 17 fathoms; and the *Hyalonema* ground, south of Japan, 345 fathoms. Millett records the species from the Malay Archipelago, and Chapman from off Great Barrier Island.

Genus PLANORBULINA d'Orbigny, 1826.

PLANORBULINA ACERVALIS H. B. Brady.

Planorbulina acervalis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 657, pl. 92, fig. 4.—Millett, Journ. Roy. Micr. Soc., 1904, p. 490.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 29, pl. 14, fig. 1; fig. 32 (in text).

There is a single specimen which is characteristic of this species.

Genus TRUNCATULINA d'Orbigny, 1826.

TRUNCATULINA LOBATULA (Walker and Jacob).

Nautilus lobatulus Walker and Jacob, Adams' Essays, Kanmacher's ed., 1798, p. 642, pl. 14, fig. 36.

Truncatulina lobatula d'Orbigny, in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, vol. 2, pt. 2, "Foraminiféres," 1839, p. 134, pl. 2, figs. 22–24.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 660, pl. 92, fig. 10; pl. 93, figs. 1, 4, 5; pl. 95, figs. 4, 5.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 256.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 31, pl. 15, fig. 1; fig. 34 (in text).

There are numerous specimens which seem to be this species.

TRUNCATULINA VARIABILIS d'Orbigny.

Truncatulina variabilis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 279, No. 8; in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, vol. 2, pt. 2, "Foraminiféres," 1839, p. 135, pl. 2, fig. 29.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 661, pl. 93, figs. 6–7.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 103.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 33, fig. 35 (in text).

There are numerous irregular specimens, some very elongate, like that figured,[1] and others more nearly circular in their general outline, all probably representing this species. The early chambers in the living coiled portion are brownish in color in the best preserved specimens.

TRUNCATULINA HAIDINGERII (d'Orbigny).

Rotalina haidingerii d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 154, pl. 8, figs. 7–9.

Truncatulina haidingerii Reuss, Sitz. kais. Akad. Wiss. Wien, vol. 55, 1867, p. 28.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 663, pl. 95, fig. 7.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 104.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 35, pl. 13, fig. 5; pl. 28, fig. 1; fig. 37 (in text).—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 257.

There are a few specimens which seem to be similar to those figured by Brady, the only difference being in the angle of the tests, which seems to be more acute than our specimens.

[1] Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p 33.

TRUNCATULINA UNGERIANA (d'Orbigny).

Rotalina ungeriana D'ORBIGNY, For. Foss. Bass. Tert. Vienne, 1846, p. 157, pl. 8, figs. 16–18.

Truncatulina ungeriana REUSS, Denkschr. Akad. Wiss. Wien. vol. 25, 1865, p. 161.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 664, pl. 94, figs. 9*a–d*.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 26, pl. 17, fig. 2; fig. 39 (in text).—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 256.

There are numerous very typical specimens of this species which seems to be a common one in the region from the published records.

TRUNCATULINA TENUIMARGO H. B. Brady.

Truncatulina tenuimargo H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 62, pl. 93, figs. 2–3.—EGGER, Abhandl. bay. Acad. Wiss. München. Cl. II, vol. 18, 1893, p. 399, pl. 16, figs. 7–9.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 102.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 257, pl. 6, figs. 20, 21.

There are two specimens mounted on the slide which are very close to Brady's figure.[1] This seems to be a rare species. There is no such development of the ventral surface as figured by Sidebottom, the extent of the elevation being similar to the figure quoted by Brady in the *Challenger* Report. This seems to be a species limited closely to the Australian region.

Genus SIPHONINA Reuss, 1849.

SIPHONINA RETICULATA (Czjzek).

Rotalina reticulata CZJZEK, Haidinger's Nat. Abh., vol. 2, 1848, p. 145, pl. 13, figs. 7–9.

Siphonina reticulata BRONN, Lethaea Geognostica, ed. 3, vol. 3, 1853–1856, p. 227, pl. 35(?), figs. 23*a–c*.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 43, pl. 16, fig. 4; pl. 28, fig. 3; fig. 48 (in text).

Truncatulina reticulata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 669, pl. 96, figs. 5–8.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 102.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 257.

There is a single specimen with a very crenulate margin, very similar in appearance to that figured by Brady.[2]

Genus ANOMALINA d'Orbigny, 1826.

ANOMALINA GROSSERUGOSA (Gümbel).

Truncatulina grosserugosa GÜMBEL, Abh. kais. bay. Akad. Wiss., vol. 10, 1868, p. 660, pl. 2, fig. 104.

Anomalina grosserugosa H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 673, pl. 94, figs. 4, 5.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 45, pl. 20, fig. 1; fig. 50 (in text).

There are numerous specimens which seem to be this species, although neither Chapman or Sidebottom record it from this region.

[1] *Challenger* Report, pl. 93, fig. 4.

[2] Idem, pl. 96, figs 5, 6.

Chapman, however, records it from Funafuti, and it is known from numerous stations in the North Pacific.

Genus CARPENTERIA Gray, 1858.

CARPENTERIA PROTEIFORMIS Goës.

Carpenteria balaniformis, var. *proteiformis* Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, 1882, p. 94, pl. 6, figs. 208–214; pl. 7, figs. 215–219.

Carpenteria proteiformis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 679, pl. 97, figs. 8–14.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 49, pl. 20, fig. 2; pl. 21, fig. 1.

There are several very typical specimens of this species which is very common in the Indo-Pacific, and well developed in the Philippines and coral-reef regions. These typical specimens have the reticulate porous wall, as shown in the figures given by Goës and Brady. There are, however, other very interesting specimens mounted on the slide with these. These are not only different in form, but also in the structure of the test, and especially in the ornamentation. One series of these has the test very thin, and the pores small and close together. Some of the specimens are loosely joined in an irregular linear series. Others are irregularly piled, and while they have the same type of test, they have an addition of a superficial thickening of material which gives them a very different appearance. This consists of more or less regular bosses on the outside of the test already formed. These thickenings are circular or irregularly elongate and are distinguished between the pores of the test. This makes an entirely different looking test from the other. (In worn specimens, even in later chambers, this secondary thickening is lacking.) The apertures also are very different in character. Some of them, as shown by Goës, are elongate and tubular, while others are sunken and have numerous spines about the borders on the two or three adjacent chambers. Altogether this forms a very interesting series. The specimens are in considerable numbers, but not sufficient to determine whether these are definite varietal characters or not.

Genus PULVINULINA Parker and Jones, 1862.

PULVINULINA CONCENTRICA Parker and Jones.

Pulvinulina concentrica (Parker and Jones, MS.), H. B. Brady, Trans. Linn. Soc., London, vol. 24, 1864, p. 470, pl. 48, fig. 14; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 686, pl. 105, fig. 1*a–b*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 51, pl. 28, fig. 4.

There are several specimens representing both early stages and the adult of this species. This species is very widely spread and shows little variation in its characters. Neither Chapman or Sidebottom seem to record it from this region.

PULVINULINA OBLONGA (Williamson.)

Nautilus auricula, var. *a*, Fichtel and Moll, 1803, Test. Micr., p. 108, pl. 20, figs. *d*, *e*, *f*.

Rotalina oblonga Williamson, Rec. Foram. Great Britain, 1858, p. 51, pl. 4, figs. 98–100.

Pulvinulina oblonga H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 688, pl. 106, figs. 4*a–c*.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 260.

There is a single typical specimen of this species which is common in the general region. Sidebottom records small specimens.

PULVINULINA cf. PATAGONICA d'Orbigny.

A single specimen may be referred to this species but it is not typical.

PULVINULINA CANARIENSIS (d'Orbigny).

Rotalina canariensis d'Orbigny, in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, vol. 2, pt. 2, "Foraminiféres," 1839, p. 130, pl. 1, figs. 34–36.

Pulvinulina canariensis Owen, Journ. Linn. Soc. London, vol. 9, Zool., 1867, p. 148, pl. 5, fig. 21.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 692, pl. 103, figs. 8–10.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 105.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 56, pl. 23, fig 1; fig. 55 (in text).—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 259.

There are numerous typical specimens, which seem to be common in the region, being recorded both by Chapman and Sidebottom.

PULVINULINA TRUNCATULINOIDES (d'Orbigny).

Rotalina truncatulinoides d'Orbigny, in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, vol. 2, pt. 2, "Foraminiféros," 1839, p. 132, pl. 2, figs. 25–27.

Pulvinulina truncatulinoides Parker and Jones, Philos. Trans., vol. 155, 1865, p. 398, pl. 16, figs. 41–43.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 105.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 59, pl. 23, fig. 4.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 259.

Pulvinulina micheliniana H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 694, pl. 104, figs. 1, 2.

There are several typical specimens of this widely spread pelagic form.

PULVINULINA SCHREIBERSII (d'Orbigny).

Rotalina schreibersii d'Orbigny, For. Foss. Bass. Tert. Vienne, 1846, p. 154, pl. 8, figs. 4–6.

Pulvinulina schreibersii Parker and Jones, Philos. Trans., vol. 155, 1865, p. 393.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 697, pl. 115, fig. 1*a–c*.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 106.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 62, fig. 59 (in text).

There are several typical specimens of this species which seems to be characteristic of the Indo-Pacific. Most of the *Challenger* material comes from this region, and I have found it to be very abundant in the Philippines. It extends as far eastward as the Hawaiian Islands and as far westward as the Red Sea and the Mediterranean.

PULVINULINA CRASSA (d'Orbigny).

Rotalina crassa D'ORBIGNY, Mém. Soc. Géol. France, vol. 4, 1840, p. 32, pl. 3, figs. 7, 8.

Pulvinulina crassa OWEN, Journ. Linn. Soc. Zool. London, vol. 9, 1867, p. 148, pl. 5, fig. 8 (?), 9.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 694, pl. 103, figs. 11, 12.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 105.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 58, pl. 27, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 259.

There are several specimens of this common species.

PULVINULINA ELEGANS (d'Orbigny).

Rotalia (*Turbinulina*) *elegans* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 276, No. 54.

Pulvinulina elegans JONES and PARKER, Geologist, vol. 7, 1864, p. 88.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 699, pl. 105, figs. 4–6.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 63, pl. 26, fig. 3.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 260.

Typical specimens occur in various stages. The species is very common in this whole general region.

PULVINULINA AURICULA (Fichtel and Moll).

Nautilus auricula, var. *a* FICHTEL and MOLL, Test. Micr., 1803, p. 108, pl. 20, figs. *a–c*.

Pulvinulina auricula PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 393.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 688, pl. 105, figs. 5*a–c*.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 105.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 53, pl. 22, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 260.

Very large fine specimens are mounted on one of the slides. This is common in comparatively deep water in the general region. Brady records it off the Philippines, and I have found it in the same region.

Genus ROTALIA Lamarck, 1804.

ROTALIA SOLDANII d'Orbigny.

Rotalia (*Gyroidina*) *soldanii* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 278, No. 5.

Rotalia soldanii HANTKEN, Mitt. Jahrb. ung. geol. Anstalt., 1875, p. 80, pl. 9, figs. 7*a–c*.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 706, pl. 107, figs. 6, 7.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 106.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 71, pl. 29, fig. 1; pl. 31, fig. 4.

The mounted specimens are very typical.

Genus GYPSINA Carter, 1877.

GYPSINA INHAERENS (Schultze).

Acervulina inhaerens SCHULTZE, Organ. der Polythal., 1854, p. 68, pl. 6, fig. 12.

Gypsina inhaerens H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 718, pl. 102, figs. 1–6.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 74, pl. 21, figs. 6, 7.

There is a single specimen, which seems to be this species.

GYPSINA VESICULARIS (Parker and Jones).

Orbitolina vesicularis PARKER and JONES, Ann. Mag. Nat. Hist., ser. 3, vol. 6, 1860, p. 31, No. 5.

Gypsina vesicularis CARTER, Ann. Mag. Nat. Hist., ser. 4, vol. 20, 1877, p. 173.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 718, pl. 101, figs. 9–12.

There are two specimens, small and poorly preserved, which may be this species. They are roughly conical in form, of light color, and similar to Brady's figures.

Genus POLYTREMA Risso, 1826.

POLYTREMA MINIACEUM (Linnaeus).

Millepora miniacea LINNAEUS, Syst. Nat., ed. 13, (Gmelin's), vol. 1, pt. 6, 1788, p. 3784, No. 6.

Polytrema miniaceum BLAINVILLE, Dict. Sci. Nat., vol. 42, 1826, Atlas, Zooph., vol. 1, p. 17.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 721, pl. 100, figs. 5–9; pl. 101, fig. 1.—HICKSON, Trans. Linn. Soc. London, Zoology, vol. 14, 1911, pp. 444, 453, pl. 30, fig. 1; pl. 31, fig. 8; pl. 32, figs. 18, 23, 27, 31.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 75, pl. 18, fig. 6; pl. 20, fig. 4.

There are several specimens of this species; two of them are the characteristic pink color; the other two are grayish white.

Family NUMMULITIDAE.

Genus NONIONINA d'Orbigny, 1826.

NONIONINA UMBILICATULA (Montagu).

Nautilus umbilicatulus MONTAGU, Test. Brit., 1803, p. 191.

Nonionina umbilicatula PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 242, pl. 12, fig. 157.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 726, pl. 109, figs. 8, 9.—CHAPMAN, Trans. New Zealand Instit., vol. 38, 1905, p. 107.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 24, pl. 17, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 262.

There are numerous well-developed specimens of this species which seems to be common in the Indo-Pacific.

Genus POLYSTOMELLA Lamarck, 1822.

POLYSTOMELLA CRISPA (Linnaeus).

Nautilus crispus LINNAEUS, Syst. Nat., ed. 12, 1767, p. 1162.

Polystomella crispa LAMARCK, Anim. sans Vert., vol. 7, 1822, p. 625, No. 1.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 736, pl. 110, figs. 6, 7.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, pl. 18, fig. 1.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 263.

There is a single specimen apparently immature. Sidebottom records a few very small weak specimens.

POLYSTOMELLA MACELLA (Fichtel and Moll).

Nautilus macellus, var. *a*, Fichtel and Moll, Test. Micr., 1803, p. 66, pl. 10, figs. *e–g*.

Polystomella macella Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 104, No. 8.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 737, pl. 110, figs. 8, 9, 11.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 33, pl. 18, fig. 3.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 263.

There are numerous finely developed specimens of this species which Sidebottom records as "two very small immature specimens."

POLYSTOMELLA MILLETTII Heron-Allen and Earland.

Polystomella verriculata Millett, Journ. Roy. Micr. Soc., 1904, p. 604, pl. 11, fig. 3.

Polystomella millettii Heron-Allen and Earland, Trans. Zool. Soc., p. 735, pl. 53, figs. 38–42.

There are five specimens which may be possibly referred to this species. They have a reticulate surface, the lines of which are oblique to the sutures. In the specimens from New Zealand, even in the last-formed chambers, there is not developed the angled condition shown by Heron-Allen and Earland in their type figures. These correspond fairly well with the figures of *P. hedleyi* figured by Jensen.[1] His specimens, however, have less of the angled pattern than is developed in our specimens, and ours are not very closely like those of Millett. From the various figures given of similar specimens of the Philippines and from this general region, there is either one very variable species or numerous varieties or species developed, and it should be carefully collected and studied in the regions to determine this.

Family MILIOLIDAE.

Subfamily Cornuspirininae.

Genus CORNUSPIRA Schultze, 1854.

CORNUSPIRA FOLIACEA Costa, var. EXPANSA Chapman.

Cornuspira carinata Costa, var. *expansa* Chapman, Biol. Res. *Endeavour*, vol. 3, 1915, p. 318, pl. 1, fig. 3.

There are several well-developed specimens which are very clearly this variety described by Chapman. Our specimens, however, are better developed than that figured by Chapman. It is very clear, both from these specimens and from abundant Philippine material, that this would be a variety of *C. foliacea*. Some of the specimens are very expanded and are nearly 4 mm. in length and nearly as much in breadth. There are slight traces of very fine longitudinal striae.

[1] Proc. Linn. Soc. New South Wales, vol. 29, 1905, p. 828, pl. 23. fig. 4.

CORNUSPIRA INVOLVENS (Reuss).

Operculina involvens REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 370, pl. 45, fig. 20.

Cornuspira involvens REUSS, Sitz. Akad. Wiss. Wien, vol. 48, 1863, p. 39, pl. 1, fig. 2.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 200, pl. 11, figs. 1-3.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 25, pl. 1, fig. 2; pl.2, fig. 2.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 11.

There is a single specimen which seems to be typical. It is microspheric.

CORNUSPIRA LACUNOSA H. B. Brady.

Cornuspira lacunosa H. B. BRADY, Rep. Voy. *Challenger*. Zoology, vol. 9, 1884, p. 202, pl. 113, fig. 21.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 26, pl. 2, fig. 3.

There are two microspheric specimens of small size which, although not very irregular in surface pattern, resemble very closely the young of this species as seen in material from the Philippines and other portions of the North Pacific.

CORNUSPIRA, species (?).

There are two microspheric specimens on one of the slides which seem to be different from any described species of this genus. The earliest coils are smooth; the later ones are covered by longitudinal or oblique costae. These are usually distinct and do not run one into the other. The transverse lines of growth are also prominent in the later portions. In the largest of the two specimens the coils become somewhat expanded but not compressed, the test being at its greatest thickness in this portion. It is not at all like *C. striolata* H. B. Brady; in form it is somewhat similar to a specimen figured by Chapman [1] from the Tertiary of Australia. Chapman's figure does not show the surface markings as in our material, but the form is very suggestive. Except for the very broad later growth it resembles *C. lacunosa*. The material of *C. lacunosa* which I had from the North Pacific showed that the last coil loses its ornamentation largely. Otherwise this largest specimen is quite similar to that form.

Genus SPIROLOCULINA d'Orbigny, 1826.

SPIROLOCULINA GRATELOUPI d'Orbigny.

Spriloculina grateloupi D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 298.—TERQUEM, Mém. Soc. Geol. France, ser. 3, vol. 1, 1878, p. 52, pl. 5, figs. 5, 6.—WEISNER, Archiv. Prot., vol. 25, 1912, p. 208.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 31, pl. 4, figs. 4, 5.

Spiroloculina excavata H. B. BRADY (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 151, pl. 9, figs. 5, 6.

There are several well-developed specimens of this species in various stages. The largest ones show adult characters very well.

[1] Journ. Linn. Soc. Zool, vol. 30, 1907, p. 24, pl. 3. fig. 48.

SPIROLOCULINA AFFIXA Terquem.

Spiroloculina affixa Terquem, Mém. Soc. Geol. France, ser. 3, vol. 1, 1878, p. 55, pl. 5 (10), fig. 13*a–c*.—Howchin, Trans. Roy. Soc. South Australia, vol. 12, 1889, p. 2.—Chapman, Journ. Linn. Soc. Zoology, vol. 30, 1907, p. 10, pl. 1, figs. 23–25.

Spiroloculina acutimargo H. B. Brady (part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 10, fig. 12 (not figs. 13–15).

Spiroloculina inaequilateralis Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 201, pl. 4, figs. 84–86; fig. 3 (in text).—Sidebottom, Mem. and Proc. Manchester Lit. and Philos. Soc., vol. 54, No. 16, 1910, p. 2, pl. 1, fig. 2.

There are a number of specimens which are very evidently this species, and show little variation in form and general characters Chapman and Howchin record this from the Tertiary of Australia Terquem described the species from the Pliocene of the Isle of Rhodes; Schlumberger described his species, which is evidently the same as Terquem's, from the Gulf of Marseille.

Sidebottom had the same species from the Bay of Palermo, Sicily. The figure given by Brady referred to above seems to be this same species. From other material that I have had it seems to be widespread and of very constant characters in this general region.

SPIROLOCULINA ANTILLEA d'Orbigny, var. RETICOSA Chapman.

Spiroloculina grata Terquem, var. *reticosa* Chapman, Biol. Res. *Endeavour*, vol. 3, 1915, p. 313, pl. 1, fig. 2.

There is a single specimen which is very clearly this variety described by Chapman from "forty miles south of Cape Wiles." It has the same peculiar surface markings as shown in the type figure, and probably has a widespread distribution about Australia and elsewhere.

Genus PLANISPIRINA Seguenza, 1880.

PLANISPIRINA SPHAERA (d'Orbigny).

Biloculina sphaera d'Orbigny, Voy. Amer. Merid., 1839, "Foraminifères," p. 66, pl. 8, figs. 13–16.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 141, pl. 2, figs. 4*a*, *b*.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 4.

Planispirina sphaera Schlumberger, Mém. Soc. Zoöl. France, 1891, p. 190, text figs. 45, 46.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 82.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 37, pl. 19, fig. 1.

There are a few specimens which have the typical V-shaped aperture.

Genus NUBECULARIA Defrance, 1825.

NUBECULARIA LUCIFUGA Defrance.

Nubecularia lucifuga Defrance, Dict. Sci. Nat., vol. 25, 1825, p. 210, Atlas Zooph., pl. 44, fig. 3.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9 1884, p. 134, pl. 1, figs. 9–16.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 41, pl. 8, fig. 6.

There are two specimens which are referred to this species. One represents several close-set chambers irregularly coiled. The other

represents an irregular linear series in which the chambers are pyriform, the basal portion being broad and rounded, the apertural end narrowed. These remind one very much of certain specimens of *Vitrewebbina*. Both specimens are attached to shell fragments.

NUBECULARIA BRADYI Millett.

Plate 75, fig. 6.

Nubecularia inflata H. B. Brady, (not *Nubecularia inflata* Terquem), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 135, pl. 1, figs. 5–8.

Nubecularia bradyi Millett, Journ. Roy. Micr. Soc., 1898, p. 261, pl. 5, fig. 6.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 41, pl. 8, figs. 4, 5.

There are numerous specimens, very irregular in shape and resembling in a general way those figured by Brady[1] and also a specimen figured by Millett. In spite of the fact of the irregularity of form, the general characters of this species seem to be well defined. The surface is smooth and polished and clear white in color.

Subfamily FISCHERININAE.

Genus FISCHERINA Terquem, 1878.

FISCHERINA PELLUCIDA Millett.

Plate 75, figs. 7, 8.

Fischerina pellucida Millett, Journ. Roy. Micr. Soc., 1898, p. 611, pl. 13, figs. 14–15.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 591.

There are two very typical specimens from this station. Heron-Allen and Earland record it from the Kerimba Archipelago off the eastern coast of Africa. Millett's specimens are from the Malay Archipelago, and with this material from New Zealand, show that the species has a wide range in the Indo-Pacific region. Heron-Allen and Earland in the same paper (p. 592) record their species *F. helix* from material collected by Mr. R. L. Mestayer from the same dredging from which our material is mounted. This species has not occurred on the series of slides I have had from the United States National Museum.

Subfamily QUINQUELOCULININAE.

Genus QUINQUELOCULINA d'Orbigny, 1826.

QUINQUELOCULINA SCLEROTICA Karrer.

Quinqueloculina sclerotica Karrer, Sitz. Akad. Wiss. Wien, vol. 58, Abth. 1, 1868, p. 152, pl. 3, fig. 5.

[1] *Challenger* Report, pl. 1, figs. 5-8.

Milolina sclerotica Balkwill and Millett, Journ. Micr., vol. 3, 1884, p. 24, pl. 1, fig. 2.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 577, pl. 44, figs. 1–4.

Several specimens with an agglutinate test seem to belong to this species which Heron-Allen and Earland have found in the Kerimba Archipelago.

QUINQUELOCULINA POLYGONA d'Orbigny.

Quinqueloculina polygona d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminiféres," p. 198, pl. 12, figs. 21–23.

There are several specimens with square-edged chambers, which seem very similar to this species described by d'Orbigny.

QUINQUELOCULINA VULGARIS d'Orbigny.

Quinqueloculina vulgaris d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 302, No. 33.—Schlumberger, Mém. Soc. Zool. France, 1893, p. 207, text figs. 13, 14, pl. 2, figs. 65, 66.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 46, pl. 11, fig. 3.
Miliolina vulgaris Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 81.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 569.

There are several specimens which can be referred to this species, which I find to be common in shallow water about the Pacific, and from the Hawaiian Islands to Japan.

QUINQUELOCULINA BICOSTATA d'Orbigny.

Quinqueloculina bicostata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, p. 195, pl. 12, figs. 8–10.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 47, pl. 13, fig. 1.
Miliolina bicostata Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 572, pl. 42, figs. 42–45.

There are a few specimens which are evidently this species and close to those figured by Heron-Allen and Earland in the above reference.

QUINQUELOCULINA DISPARILIS d'Orbigny.

Quinqueloculina disparilis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 302, No. 21.—Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 212, pl. 2, figs. 55–57, figs. 21, 22 (in text).—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 48, pl. 14, fig. 1.

This species, which is very characteristic of this whole region in shallow water, occurs in the mounted material. In the Philippines it is a very common and widely distributed species, and evidently typical of the Indo-Pacific.

QUINQUELOCULINA BRADYANA Cushman.

Miliolina undosa H. B. Brady, (not *Quinqueloculina undosa* Karrer), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 176, pl. 6, figs. 6–8.
Quinqueloculina bradyana Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 52, pl. 18, fig. 2.

A few specimens which are close to the figures of this species which I have given (pt. 6, 1917, pl. 18, fig. 2) are mounted. From Brady's

figures and the material I have had, it seems to be a species widely distributed in the Indo-Pacific.

Genus HAUERINA d'Orbigny, 1848.

HAUERINA FRAGILISSIMA (H. B. Brady).

Spiroloculina fragilissima H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 149, pl. 9, figs. 12–14.

Hauerina fragilissima Millett, Journ. Roy. Micr. Soc., 1898, p. 610, pl. 13, figs. 8–10.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 64, pl. 24, fig. 4.

There is a single specimen which is evidently the young of this species, although the aperture is not cribrate. The surface is very smooth and polished, very thin, and the edge rounded. The records for this species are all from this general region.

Genus TRILOCULINA d'Orbigny, 1826.

TRILOCULINA TRIGONULA (Lamarck).

Miliolites trigonula Lamarck, Ann. du Mus., vol. 5, 1804, p. 351, No. 3.

Triloculina trigonula d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 1, pl. 16, figs. 5–9.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 65, pl. 25, fig. 3.

Miliolina trigonula Williamson, Rec. Foram. Great Britain, 1858, p. 83, pl. 7, figs. 180–182.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 164, pl. 3, figs. 14–16.

There are a few specimens which are typical of this species.

TRILOCULINA TRICARINATA d'Orbigny.

Triloculina tricarinata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 7.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 66, pl. 25, figs. 1, 2.

Miliolina tricarinata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 165, pl. 3, fig. 17*a*, *b*.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 7.

There are two specimens of this species, of the broad short form, in which the breadth and the length are nearly equal.

TRILOCULINA CIRCULARIS Bornemann.

Triloculina circularis Bornemann, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 349, pl. 19, fig. 4.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 67, pl. 25, fig. 4; pl. 26, fig. 1.

Miliolina circularis H. B. Brady, Rep.? Voy. *Challenger*, Zoology, vol. 9, 1884, p. 169, pl. 4, fig. 3*a–c*; pl. 5, figs. 13, 14.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 81.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 8.

One or two specimens among those mounted are quite definitely this species, which is common in shallow and warm waters.

TRILOCULINA OBLONGA (Montagu).

Vermiculum oblongum Montagu, Test. Brit., 1803, p. 522, pl. 14, fig. 9.

Triloculina oblonga d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 300, No. 16.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 69, pl. 26, fig. 3.

Miliolina oblonga H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 160, pl. 5, figs. 4*a*, *b*.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 7, pl. 1, figs. 15, 16.

There are four rather typical specimens of this species mounted on one of the slides.

TRILOCULINA LABIOSA d'Orbigny.

Triloculina labiosa d'Orbigny, in De La Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminiféres," p. 157, pl. 10, figs. 12–14.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 70.

Miliolina labiosa H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 170, pl. 6, figs. 3–5.

There are several rather small and typical specimens which should be referred here. The specimens show about the same range of variation as those figured by Brady.

TRILOCULINA ROTUNDA d'Orbigny.

Triloculina rotunda d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 4.—Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 64, pl. 1, figs. 48–50; figs. 11, 12 (in text).

Miliolina rotunda Millett, Journ. Roy. Micr. Soc., 1898, p. 267, pl. 5, figs. 15, 16.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 568, pl. 42, figs. 27–30.

There are numerous well-developed specimens of this species which, according to the records, must be widely spread in the Indo-Pacific, being recorded from the Kerimba Archipelago by Heron-Allen and Earland, from the Malay Archipelago by Millett, and from this material off New Zealand. It is also recorded from the Mediterranean and the Atlantic.

Genus BILOCULINA d'Orbigny, 1826.

BILOCULINA ANOMALA Schlumberger.

Biloculina anomala Schlumberger, Mém. Soc. Zool. France, vol. 4, 1891, p. 182, pl. 11, figs. 84–86; pl. 12, fig. 101, text figs. 32–34.—Chapman, Trans. New Zealand Instit., vol. 38, 1905, p. 80.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 79, pl. 32, fig. 1.

Several specimens seem very close to the figures given by Schlumberger, and I have had the species from the Hawaiian Islands. Chapman records it from off Great Barrier Island. Schlumberger's type material is from the Mediterranean.

BILOCULINA PISUM Schlumberger.

Biloculina pisum Schlumberger, Mém. Soc. Zool. France, vol. 4, 1891, p. 569 pl. 11, figs. 81–83; fig. 31 (in text).—Chapman, Trans. New Zealand Instit.. vol. 38, 1905, p. 80.

There are several specimens, which, from their surface characters, might belong to either this species or *B. vespertilio* Schlumberger.

Chapman, however, has had material from this same general region which he has sectioned and determined as *B. pisum;* therefore probably these specimens belong to the same species.

BILOCULINA SARSII Schlumberger.

Biloculina ringens H. B. Brady (not *B. ringens* Lamarck), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 142, pl. 2, fig. 7.

Biloculina sarsii Schlumberger, Mém. Soc. Zool. France, vol. 4, 1891, p. 166, pl. 9, figs. 55–59, text figs. 10–11.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 76, pl. 30, fig. 2.

There are fine large specimens which may be referred to this species that are mounted on one of the slides. I had material from the North Pacific, from the Hawaiian Islands, westward to Japan, and, from this material, it is evidently widespread in the Indo-Pacific.

BILOCULINA BRADYI Schlumberger.

Biloculina bradyi Schlumberger, Mém. Soc. Zool. France, vol. 4, 1891, p. 170, pl. 10, figs. 63–71; figs. 15–19 (in text).

This seems to be one of the commonest species of this genus in the material. The very broad flattened lip is very characteristic.

BILOCULINA COMATA H. B. Brady.

Biloculina comata H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 45; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 144, pl. 3, figs. 9*a*, *b*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 81, pl. 34, fig. 1.

There are three specimens of a striate triloculine form which are close to the figures of *Miliolina insignis*, given by Brady in the *Challenger* Report. From other material I have seen in the Pacific, it seems that this may be the triloculine stage of *B. comata*.

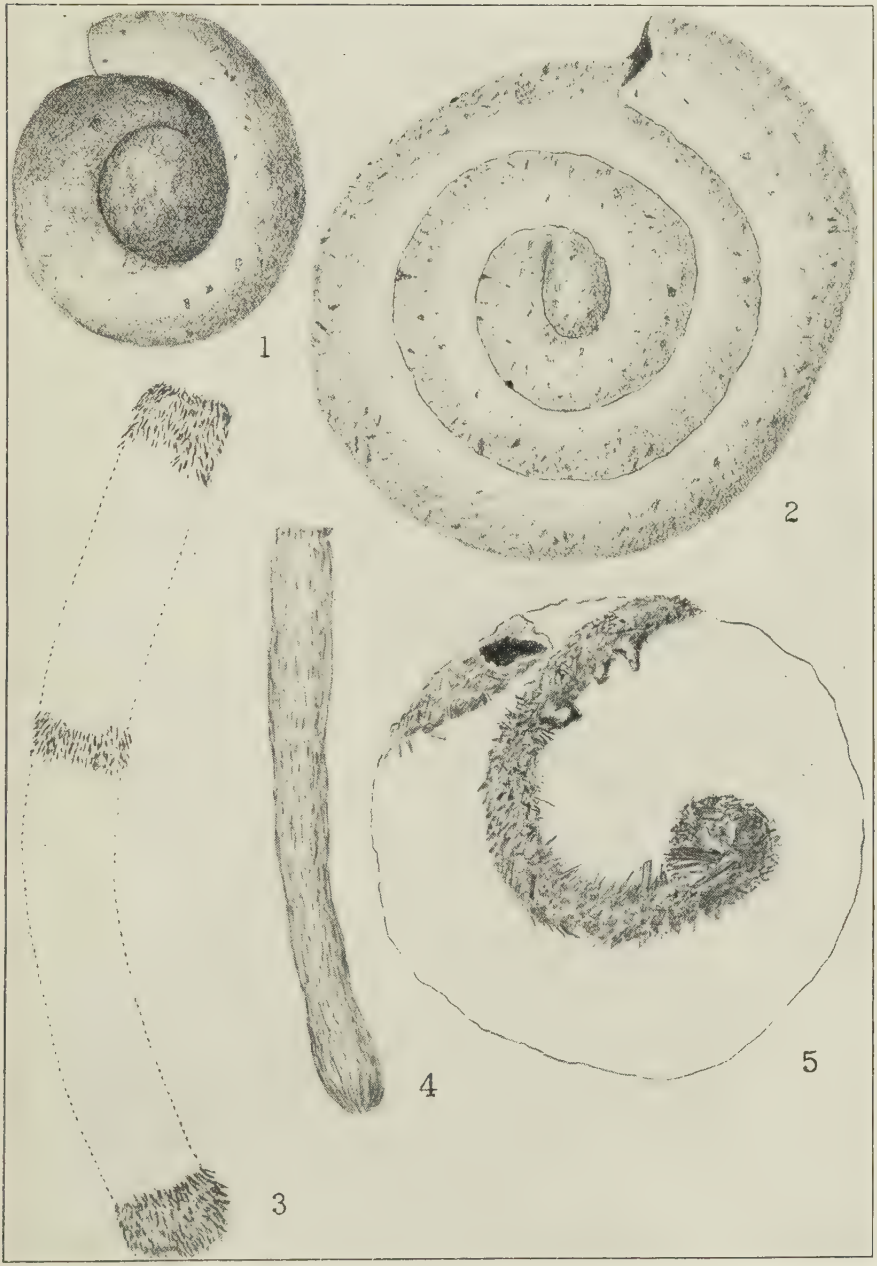
EXPLANATION OF PLATES.

Plate 74.

Fig. 1. *Ammodiscus mestayeri*, megalospheric specimen × 25.
2. *Ammodiscus mestayeri*, microspheric specimen × 25.
3. *Hyperammina mestayeri*, microspheric specimen × 10.
4. *Technitella mestayeri* × 40.
5. *Tolypammina horrida* × 20.

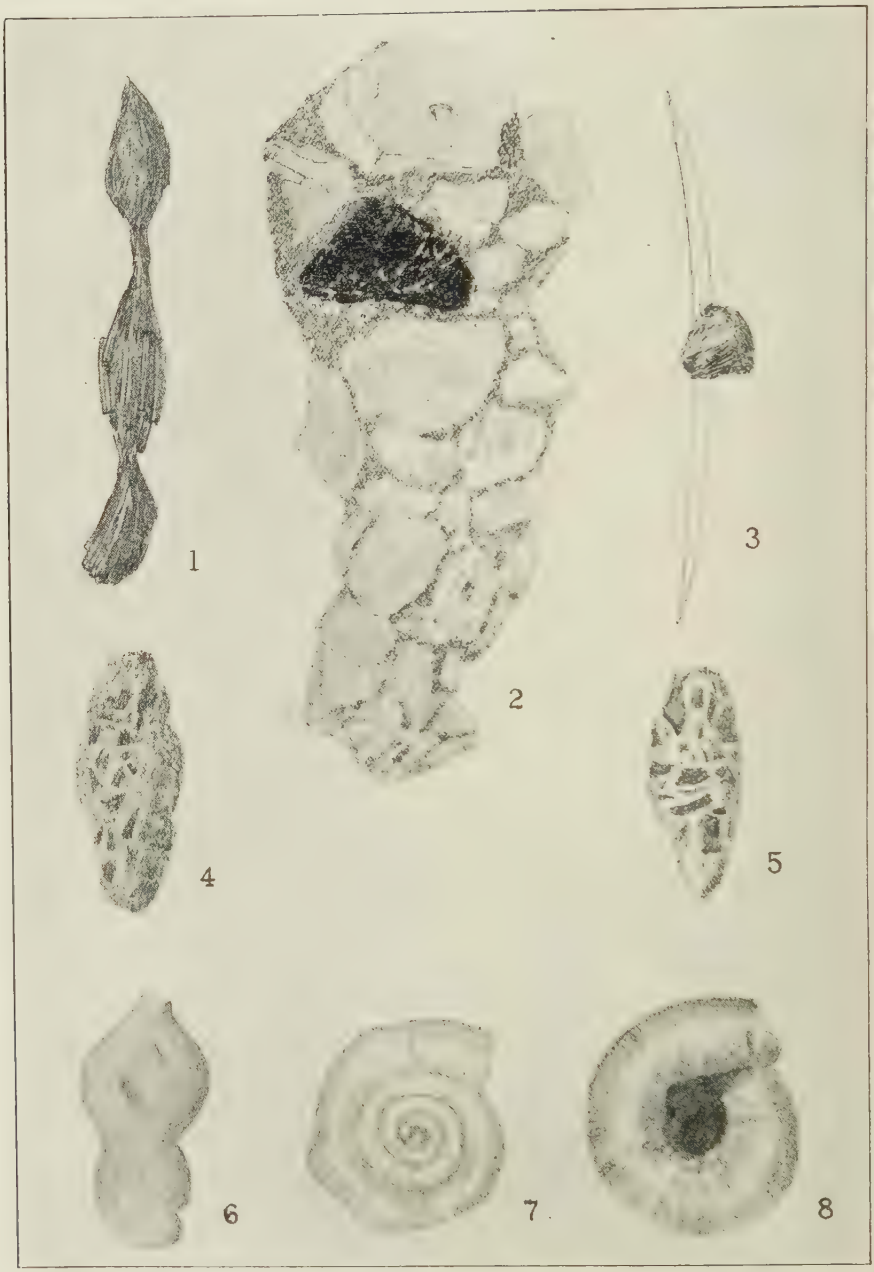
Plate 75.

Fig. 1. *Reophax spiculifera*, var. *pseudodistans* × 25.
2. *Reophax advena* × 30.
3. *Psammosphaera parva*? × 30.
4, 5. *Nouria polymorphinoides* × 30.
6. *Nubecularia bradyi* × 30.
7. *Fischerina pellucida*, dorsal view × 30.
8. *Fischerina pellucida*, ventral view of another specimen × 30.



RECENT FORAMINIFERA FROM OFF NEW ZEALAND

FOR EXPLANATION OF PLATE SEE PAGE 610



RECENT FORAMINIFERA FROM OFF NEW ZEALAND

FOR EXPLANATION OF PLATE SEE PAGE 640

THE RED SPIDERS OF AMERICA AND A FEW EUROPEAN SPECIES LIKELY TO BE INTRODUCED.

E. A. McGregor,[1]

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The so-called red spiders or spinning mites (which were all included in the genus *Tetranychus* until within the last few years) are without doubt the most important economically of the mites, and cause great damage annually to many of the most valuable cultivated plants. The writer has previously estimated that at normal prices the cotton crop of the United States may suffer through the ravages of the common red spider (*Tetranychus bimaculatus* Harvey) to the extent of $2,000,000. Leading crops in various parts of the world are known to suffer similarly.

As Trägårdh and others have pointed out, the systematic knowledge of the red spiders is by no means on a plane with the comprehension of their economic status. Moreover, not until the completion, recently, of the investigation of the red spider on cotton (23)[2] by the Bureau of Entomology, was much known as to accurate details of their biology. Banks in the United States and Berlese in Europe were the pioneers who undertook the taxonomic separation of the species of this group. As Zacher (13) and the present writer (20) have already pointed out, the ordinary microscopic equipment with which these mites previously have been studied was far too crude, and only on such grounds could the finer taxonomic details have escaped such excellent observers as the two above mentioned pioneer acaridologists.

In Banks's Red Spiders of the United States (9) he separates the species chiefly through the palpal and tarsal characters. These are still very useful in the taxonomy of the group, but to them have been added the so-called collar tracheae and the penis. In order properly to examine these structures it is absolutely necessary to employ an

[1] Since this paper was written the author has resigned from the Bureau of Entomology.

[2] The numbers in parentheses refer to "References" at the end of this paper.

oil-immersion lens. H. E. Ewing (17) and the present writer have already pointed out that a careful examination of red spider species with up-to-date equipment has revealed the fact that the tarsal and palpal structures are not nearly as simple as Banks (9) and other earlier workers have indicated. Also for years it was believed that each of the numerous host plants supported a distinct species, and that each of the many color forms represented a species. In this manner a very annoying confusion regarding synonymy arose, which has not been entirely straightened out at the present writing.

A sort of controversy has arisen between certain of the recent workers concerning the correct nomenclature of the microscopic structural parts of the tip of the tarsus. Trägårdh (18) claims that Zacher and Ewing each had the wrong conception of what constitutes the empodium. The former asserts that the bases of the tenent hairs are homologous with the claws of other mites. He claims that what Banks, Ewing, and others have been calling the true claw is but the empodium which in the several species is variously modified so as to exhibit from one to six claw divisions.

It was Zacher (13) who first recognized the importance of the penis as possessing specific variations, and Ewing (15) followed soon after with an amplification of the penis characters. Trägårdh (18) also recognizes the taxonomic value of the variation shown by the penis of the various species. The present writer's studies have similarly tended to corroborate the opinions of the above workers as to the value of the penis in possessing specific characters. Dr. W. Dwight Pierce has pointed out to the writer the resemblance of this chitinous organ to the oedeagus of insects, especially the Strepsiptera. He believes that the penis will be found to be a delicate extrusible tube within this chitinous oedeagus. Perhaps detailed study will bear him out. The writer has not had this opportunity as the suggestion was made while Doctor Pierce was reading over the completed manuscript.

The "thumb" or terminal joint of the palpus has long been accorded a place of importance among the taxonomic structures. The characters of this member, however, appear through recent studies to be rather too constant to furnish specific features of a very satisfactory nature. There are almost without exception seven appendages, including, two "fingers," two digituli, and three short hairs. About the only characteristics of these appendages that appear useful are the outlines of the terminal and the dorsal "fingers" and their proportionate sizes one to the other.

The dorsal body bristles or appendages also offer some assistance in the taxonomy, although, aside from the two members of the genus *Anychus*, the number and arrangement of these hairs seem to be nearly constant.

Trägårdh (18) very fortunately discovered the utility of the collar trachea as a help in the differentiation of the species. In certain species this organ is V-shaped with both arms of equal caliber; in some it is also V-shaped but with one arm much thicker than the other; while in other species the collar trachea is straight with a bladder-like enlargement at its end.

As to any taxonomic importance being attributed to the respective colors of the various species, there is much doubt. Ewing (17) conducted some interesting tests, the results of which indicated that the various shades of green, yellow, orange, brown, and black were attributable to the presence in the blood, tissues, or fecal matter of chlorophyll, or other pigments derived from it through the process of metabolism. The investigations of the present writer (23) of *T. bimaculatus* in South Carolina indicated that the species was subject to much variation in color and that individuals about to enter the wintering existence often became a salmon-yellow color. At various seasons and under varying conditions individuals of the two-spotted mite could be found of nearly all shades exhibited by any species of red spider. It would seem that the color pattern rather than the general color of the species is the important factor.

Once more it is important to emphasize that the minuteness of the taxonomic structures together with the aggravating light refraction when employing great magnifications makes the definite conception of the microscopic image extraordinarily difficult. This has also been mentioned by a few other workers.

The red spider body is oval or elliptical, furnished with a score or more of dorsal cuticular appendages arranged in four rows. These appendages are usually long and hairlike and either simple or finely plumose, or are in the form of short, rather stout rods. The cephalothorax is separated from the abdomen by a slight constriction, and bears on each side one or two simple eye corneas. The pedipalps are short, the third joint ends dorsally in a strong claw; the last joint is thumblike and bears one or more appendages called "fingers," as well as digituli and sense hairs. In all species examined the palpus of the male bears dorsally on the distal margin of the second joint a strong spur. The basal portion of the mandibles are fused to form a broad retractile plate, the apical portion of which is produced into the slender piercing stylet. The legs, the first pair of which are longest, are never much longer than the body, with scattered hairs, the tarsus terminating in claw appendages which vary greatly in arrangement: the name *Tetranychus* is based upon those species the tarsal claw of which is split into four parts. The anal and genital openings occur ventrally near the tip of the abdomen; the former is terminal, the latter basal.

KEY TO GENERA.

a^1. Empodial claw vestigial, connate at base to tarsus of which it is merely a protuberance.....*Anychus*, new genus.

a^2. Empodial claw distinctly separated at base from distal portion of tarsus.

b^1. Claw simple.....*Neotetranychus* Trägårdh.

b^2. Claw complex.

c^1. Claw cleft with from 2 to 6 equal divisions.

d^1. Claw divisions 2.....*Schizotetranychus* Trägårdh.

d^2. Claw divisions 4[1] to 6.....*Tetranychus* Dufour.

c^2. Claw appendiculate either at base or at a point between it and middle point with from 4 to 6 spurs.

d^3. Dorsal spur of tarsus decidedly shorter than the ventral group of spurs.....*Septanychus*, new genus.

d^4. Dorsal spur more prominent and much longer or about equaling the appendiculate spurs: collar trachea straight, enlarged at end. *Paratetranychus* Zacher.

ANYCHUS, new genus.

This genus is thus far represented by a species from Florida and one from Peru, South America.

Spinning mites, having only a vestigial claw which is connate at base with the tarsus of which it forms merely a protuberance. The usual series of dorsal bristles is replaced by a series of rodlike or spatulate appendages.

Type.—*Tetranychus* (*Anychus*) *banksi* McGregor.

KEY TO SPECIES OF GENUS ANYCHUS.

a^1. "Finger" on tip of palpal "thumb" terminal and much stouter than the two digituli, at base nearly as thick as tip of "thumb": dorsal appendages 18, spatulate-serrate.....*A. banksi* McGregor.

a^2. "Finger" on tip of palpal "thumb" ventro-terminal, less conspicuous than the two digituli, at base about one-fourth as thick as tip of "thumb"; dorsal appendages 26, nontapering, serrate, rodlike.....*A. rusti* McGregor.

ANYCHUS BANKSI (McGregor).

Tetranychus banski McGregor, 1914, Ann. Ent. Soc. Amer., vol. 7, no. 4, p. 357.

Color rusty red, from underlying paired organs which occupy all of the dorsal region excepting a median abdominal area and a clear area containing the mandibular plate. Eyes (in mounted material) translucent, directly over suture between coxae I and II. The usual series of dorsal bristles is lacking, but a series of 18 spatulate-serrate hairlike appendages are distributed on the dorsal aspect of the body as follows: One at either side of the mandibular plate anteriorly, one just mediad of each eye, one just overlying each coxa II, six forming a fringe at hind margin of body, and three along

[1] All recent European authorities show four divisions of the tarsal claw for *T. telarius* and *T. althaeae* and others, but this type has not yet been seen in this country.

each side of abdomen. Body of female rhombic-ovate, widest across cephalothorax, exceedingly obese for the size of the legs; cephalothorax rounded generally anteriorly with a slight concave border overlying the palpi; male almost sagitate in outline, conspicuously reduced in proportion to the legs. Mandibular plate about half again as long as wide, tapering somewhat anteriorly, with a distinct emargination and with a superimposed chitinized ridge anteriorly. "Thumb" of palpus subconical, upper surface twice transversely depressed with an intervening dilation, bearing at its tip a long slender "finger," which is over four times as long as thick; on its upper side arising between middle and tip are two stout hairs, and near the base of upper side arise a reduced "finger" and two stout hairs; the claw of the penultimate joint reaches only to the basal "finger"; a hair arises ventrally from the "thumb" and another laterally from the penultimate joint. Legs of female are of average length, barely equaling length of body; those of male are about twice as long as body; femur between four and five times as long as thick, three-quarters again as long as tarsus; tibia somewhat longer than patella, which is over twice as long as trochanter; relative length of joints as follows: Coxa, 9; trochanter, 3.75; femur, 14; patella, 8.75; tibia, 10.9; tarsus, 8; tip of tarsus not provided with a claw, it being reduced to a vestigial protuberance; the customary series of four tenent hairs arise from the onychium.

Type.—Cat. No. 19089, U.S.N.M.

The type material was from Orlando, Florida, August 16, 1913, from the under surface of castor beans (*Ricinus communis*) and velvet bean leaves. Mr. W. W. Yothers writes that the species is an important pest of the castor bean plant in Florida, but that at times it is controlled by a predaceous mite (*Sciulus*, species) and by the coccinellid *Stethorus*, species. Larvae and pupae of *Arthrocnodax carolina* have been observed on infested castor bean leaves from Orlando, Florida.

ANYCHUS RUSTI (McGregor).

Tetranychus rusti McGregor, 1917, Proc. U. S. Nat. Mus., vol. 51, p. 582.

Color ranging from yellowish or greenish to red. Eyes (in mounted material) translucent, directly over coxae II and between subfrontal and posterior cephalothoracic bristles. The dorsal epidermal appendages are not distributed to conform with the usual arrangement for this genus, but a series of 26 moderately short, nontapering, sparsely serrate, rod-like appendages are distributed on the dorsal aspect of the body as follows: One at either side of mandibular plate anteriorly, one just anterior to each eye, one just posterior to each eye, six forming a fringe at hind margin of body, three along each side of abdomen, one on either side of median axis in line with coxae III,

and one on either side of median line near hind margin of abdomen. Body of female ovate, widest across front region of abdomen, slightly obese for the size of the legs; cephalothorax rather evenly rounded anteriorly with a slight truncate border overlying the palpi; male elongate- sagitate in outline, legs conspicuously long for size of body. Mandibular plate slightly over half as wide as long, tapering gradually forward, with almost no emargination anteriorly. "Thumb" of palpus subcylindrical, belling considerably at base, upper surface indented near central point; tip of "thumb" bearing three "fingers," one at inferior angle conical and three times as long as thick, one at superior angle slender and eight times as long as thick; a slender "finger" between these at inner angle which in size is intermediate between them. A reduced "finger" and a slender spine arise side by side from the indentation of the upper side of "thumb." The claw of the penultimate joint reaches to the subbasal "finger." Legs of female are of average length, barely less than that of body; those of male are slightly more than half again as long as body. Femur nearly five times as long as thick, from three-quarters again to twice as long as tarsus. Tibia about a quarter again as long as patella, which is two and one-half times as long as trochanter. Relative lengths of joints are as follows: Coxa, 6; trochanter, 4; femur, 15; patella, 10.3; tibia, 12.7; tarsus, 8.5. Tip of tarsus not provided with a claw. The usual series of four tenent hairs arise from the end of the onychium.

Type.—Cat. No. 20170, U.S.N.M.

The type material was from Mira Flores Station, Departmento de Piura, Hacienda "San Jacinto," Peru, South America, October 15, 1912, on papaya (*Carica papaya*). Mr. E. W. Rust, the collector, states that the species in life behaves much like *T. bimaculatus*, and injures the tender leaves of the papaya by feeding on the upper surface.

Genus NEOTETRANYCHUS Trägårdh.

Neotetranychus Trägårdh, 1915, Med. Nr. 109 fr. Centr. f. förs. på jordbr. Entom. avdel. Nr. 20, p. 20.

This genus is thus far represented by a species from Europe and a species from Illinois.

Spinning mites with empodial claw undivided and without subbasal appendages, sickle-shaped, slightly dentate at end; collar tracheae of the *Tetranychus* type, but with posterior limb much wider; penis strongly hooked and attenuate, unbarbed.

Type.—*Neotetranychus rubi* Trägårdh, originally designated.

KEY TO SPECIES OF GENUS NEOTETRANYCHUS.

a^1. Empodial claw sickle-shaped, strongly curved, dentate at tip; tenent hairs four—
Neotetranychus rubi Trägårdh.

a^2. Empodial claw slightly curved, very sharp at tip; tenent hairs two—
Tetranychus (*Neotetranychus*) *uniunguis* Ewing.

NEOTETRANYCHUS RUBI Trägårdh.

Trägårdh (18) erected this genus in 1915 for a Swedish red spider which was only observed on wild raspberries in the autumn. He states that "to this genus belong *bicolor* Banks and *modestus* Banks, which both have a simple, claw-shaped empodium." A careful study of Banks's types, as elsewhere indicated, shows that in both the above species the empodial claw is furnished with the group of subbasal appendages, thus placing them in the genus *Paratetranychus*.

NEOTETRANYCHUS UNIUNGUIS (Ewing).

Tetranychus uniunguis Ewing, 1917, Journ. Econ. Ent., vol. 10, no. 5, p. 497.

A greenish-yellow species. Palpi rather stout, reaching the tip of tibia of leg I. Palpal claw rather short, strongly curved, and not very sharp at its tip. "Thumb" of palpus stout, as broad as long, reaching but not surpassing the palpal claw; "finger" of "thumb" situated in middle of the apex, about twice as long as broad, and rounded at its tip. Hairs of "thumb" distributed as follows: Two small ones on the inside of "thumb" near its apex, one long hair, about as long as the "thumb" itself, on the inside near the base; and another of about equal length on top not far from the base. Chelicerae each arising near the base of plate, and making an evenly rounded loop posteriorly, and then passing forward for about two-thirds their length, then in a downward direction to their tips. The only place that the chelicerae are swollen is near their bases. Tarsus of leg I considerably longer than the tibia. Tarsi each ending in a single claw, which is not strongly curved, but is very sharp; two tenent hairs. Length, 0.59 mm.; width, 0.42 mm.

Fig. 1.—Neotetranychus uniunguis Ewing-Palpal appendages (after Ewing).

From Urbana, Illinois; on arbor vitae (*Thuja occidentalis*).

Genus SCHIZOTETRANYCHUS Trägårdh.

Schizotetranychus Trägårdh, 1915, Med. Nr. 109, fr. Centr. f. förs. på jordbr. Entom. avdel Nr. 20, p. 19.

This genus is represented at present by a species in Germany and one in the United States.

Red spiders with empodial claw possessing two subequal simple divisions; penis with a large basal lobe and with a coarse tip.

Type.—Schizotetranychus schizopus Zacher, originally designated.

KEY TO SPECIES OF GENUS SCHIZOTETRANYCHUS.

a^1 Palpal "thumb" without digit; tarsus I very broad and truncate at tip, two claws subequal.....*Schizotetranychus latitarsus* Ewing.

a^2 Palpal "thumb" with slender terminal "finger" and adjacent digitulus; two strong-curved tarsal claws; penis broader than that of *telarius*, with an obtuse basilar lobe.....*Schizotetranychus schizopus* Zacher.

Trägårdh (18) writes: "To this genus (*Schizotetranychus*) probably belongs *T. mytilaspidis* Riley,[1] and to judge from Ewing's description of it, and Zacher's figure of *S. schizopus* the penes of the two species seem to be of the same shape." However, a comparison of Zacher's figure 4 and the writer's figure 4,[2] of the penis of *S. schizopus* and *T. citri* (*mytilaspidis*, authors not Riley) respectively, shows rather conclusively the marked difference in the penis type; furthermore, as elsewhere stated herein, it develops that the tarsal claw of *Tetranychus citri* McGregor is not simply two cleft, but possesses in addition four empodial spurs, and is accordingly referable to a different genus—Paratetranychus.

SCHIZOTETRANYCHUS SCHIZOPUS Zacher.

Tetranychus schizopus ZACHER, Jan., 1910, Mitt. Kais. Biol. Anst. f. Land- und Forst., Heft 9, p. 40.

Zacher (13) described this species in 1910 from material on various species of willows collected at Dahlem, Germany.

SCHIZOTETRANYCHUS LATITARSUS Ewing.

Schizotetranychus latitarsus EWING, 1917, Journ. Econ. Ent., vol. 10, no. 5, p. 498.

Preserved specimens yellowish and reddish, with dark spots showing through the body wall. Cephalothorax fully as broad as long. Mandibular plate or rostrum over twice as long as broad. Apparently two eyes on each side of cephalothorax, but only one with a perfect cornea. Palpi prominent; palpal claw very short, stout, and but slightly hooked; "thumb" swollen, short, not reaching tip of claw and apparently without digit. Abdomen rather strongly arched and evenly rounded behind except for the anal papilla. Above the abdomen is sparsely clothed with long, prominent, slightly curved, minutely pectinate setae. Legs moderate; tarsus of leg I but slightly longer than tibia, very broad and truncate at its tip; at its tip above it bears a large tactile seta much longer than the tarsus itself. The tarsi of the legs are each provided distally with two subequal, simple claws, and four tenent hairs; of the latter the two inner are longer than the two outer, and all are at least twice as long as the claws. Length, 0.36 mm.; width, 0.23 mm.

FIG. 2. SCHIZOTETRANYCHUS LATITARSUS EWING. TARSUS AND ITS APPENDAGES (AFTER EWING).

From Pasadena, California; on bamboo; by C. P. Clausen. Described from several specimens. This species is probably an introduced one, according to Ewing.

[1] The true *mytilaspidis* Riley belongs to the genus *Penthalodes* and is not a red spider.

[2] Ann. Ent. Soc. Amer., vol. 9, no. 3, pl. 14.

Genus TETRANYCHUS Dufour.

Tetranychus DUFOUR, 1832, Ann. Sci. Nat., vol. 25, p. 276.

Until quite recently there were included under this generic name practically all the red spiders or spinning mites. As designated by the most recent workers, however, there are included in this genus only those species in which the empodial claw is divided into from four to six subequal divisions. Based on this new conception of the genus there are in Europe three or four species and in America about ten species. With respect to the tarsal, palpal, and collar trachea characters, there is rather good coordination among the several species of Tetranychus; on the other hand, the penis exhibits rather radical variation within the genus. With a very few exceptions the more important red spiders economically are contained within this genus.

Red spiders the empodial appendage of which is cleft to the middle or more with from four to six subequal divisions, the whole strongly bent near middle; collar trachea V-shaped, of about the same caliber throughout.

Type—Tetranychus telarius Linnaeus, designated by Trägårdh, 1915.

KEY TO SPECIES OF THE GENUS TETRANYCHUS.

1. Empodial appendage four-cleft 2
   Empodial appendage more than four-cleft 3
2. Penis slender; basilar lobe obtusely sharp-angled; shaft slender, strongly hooked, acuminate without barb ..... *T. telarius* Linnaeus.
   Penis shaft rather broad, with a small protuberance on the concave side, weakly hooked and blunt pointed; male tarsus with three-cleft empodial claw; collar trachea U-shaped, anterior arm twice as long but of same caliber as posterior arm ..... *T. althaeae* Von Hanstein.
   Penis much broader; basilar lobe in the form of a broad rectangular projection; shaft rather stout, weakly hooked, with a truncate pseudo-barbed tip. *T. ludeni* Zacher.
3. Empodial appendage five-cleft; penis somewhat undulate, sting-like, unbarbed. *T. flavus* Ewing.
   Empodial appendage six-cleft 4
4. Empodial appendage six-cleft, tip of tarsi broad, truncate, each bearing very long tactile seta; palpal "thumb" with at least 5 digituli near tip. *T. multidigituli* Ewing.
   Empodial appendage six-cleft, tarsus narrowed toward tip, palpal "thumb" with only two digituli near tip 5
5. Penis shaft tapering without well-defined hook 7
   Penis shaft stouter with well-defined hook 6
6. Collar trachea U-shaped; penis with small, hooklike dorsal basilar lobe, and stout upturned hook bearing recurved barb ..... *T. bimaculatus* Harvey.
   Collar trachea V-shaped; penis with prominent dorsal basilar lobe, and strong upturned hook bearing a barb, the posterior tip of which is produced into a long, sharp spur ..... *T. pacificus*, new species.
7. Tip of penis with knoblike barb, basilar lobe about equal to inner lobe in length. *T. borealis* Ewing.

Tip of penis obliquely truncate and produced ventrally into a very inconspicuous spur; basilar lobe merely an obtuse prominence: collar trachea pipe-shaped, with slender almost straight ventral arm and very short swollen dorsal arm.
T. sexmaculatus Riley.

Tip of penis narrowly rounded without barb, basilar lobe absent.
T. weldoni Ewing.

Tip of penis sharply acuminate 8

8. Penis shaft somewhat undulate; collar trachea sickle-shaped; empodial claw not cleft as deeply as usual, divisions closely appressed ... *T. willamettei* McGregor.
Penis shaft straight, sting-like: empodial claw divisions deeply cleft, two ventral divisions much heavier 9

9. Collar trachea pipe-shaped with anterior arm about four times as long as posterior arm, which forms a thickened elliptical chamber ..... *T. oregonensis* McGregor.
Collar trachea L-shaped, with anterior arm about twice as long as posterior arm, which is of somewhat thinner caliber than the anterior arm .....
..... *T. monticolus* McGregor.

TETRANYCHUS TELARIUS (Linnaeus).

Plate 79, fig. 7.

1761. *Acarus telarius* Linnaeus, Faun. Suec., p. 431.—1804, *Trombidium t.* Hermann.—1834, *Tetranychus t.* Dugès.
1804. *Trombidium tiliarium* Hermann.—1834, *Tetranychus t.* Dugès.—1867, *Acarus t.* Turpin.—1875, *Tetranychus t.* Koch.
1804. *Trombidium maius* Hermann.—1834, *Tetranychus m.* Dugès.
1804. *Trombidium tenuipes* Hermann.—1834, *Tetranychus t.* Dugès.
1804. *Trombidium socium* Hermann.—1867, *Acarus s.* Müller.—1875, *Tetranychus socius* Koch.
1832. *Tetranychus lintearius* Dufour.—1867, *Acarus l.* Boisduval.—1877, *Tetranychus l.* Murray.
1867. *Acarus russulus* Boisduval.—1875, *Tetranychus r.* Koch.
1867. *Acarus tini* Boisduval.—1877, *Tetranychus t.* Murray.
1867. *Acarus cucumeris* Boisduval.—1877, *Tetranychus c.* Murray.
1867. *Acarus rosarum* Boisduval.—1877, *Tetranychus r.* Murray.
1867. *Acarus cinnabarinus* Boisduval.—1877, *Tetranychus telarius* var. *c.* Murray.
1867. *Acarus haematodes* Boisduval.—1877, *Tetranychus telarius* var. *h.* Murray.
1867. *Acarus vitis* Boisduval.—1877, *Tetranychus v.* Murray.
1867. *Tetranychus ferrugineus* Boisduval.
1875. *Tetranychus urticae* Koch.
1875. *Tetranychus fervidus* Koch.
1875. *Tetranychus populi* Koch.
1875. *Tetranychus piger* Donnadieu.
1875. *Tetranychus minor* Donnadieu.
1875. *Tetranychus longitarsis* Donnadieu.
1875. *Tetranychus plumistoma* Donnadieu.
1875. *Tetranychus rubescens* Donnadieu.
1875. *Phytocoptes epidermi* Donnadieu.
1875. *Phytocoptes gallarum* Donnadieu.
1875. *Phytocoptes nervorum* Donnadieu.

This acarid is the pioneer of all red spiders, having first been described in 1761 by Linnaeus (1), from material on linden trees, calling it *Acarus telarius*. Throughout Europe it is best known as the linden mite from which host the specific name is derived. This red spider

has long been recognized as an economically important species, and has been treated taxonomically and economically by many workers since Linnaeus, including Boisduval, Lucas, Whitehead, Murray, Ormerod, Oudemans, Berlese, Canestrini, Fanzago, Von Hanstein, Tullgren, Noel, Bruyant, Keiffer, Trägårdh, Banks, and Ewing.

Among American workers Ewing (17) alone has claimed that the common red spider described in 1892 by Harvey as *T. bimaculatus* is identical with the linden mite. He claims also that *T. sexmaculatus* Riley and *T. gloveri* Banks are synonyms of *T. telarius*. The present writer believes he has established in the present work the valid specific distinction of each of these excepting *T. gloveri*, which he finds to be identical with *T. bimaculatus*.

The linden mite of Europe is the smallest of the true *Tetranychus* species. It feeds commonly on linden, elm, horse-chestnut, maple, aspen, and bird-cherry. In Europe *T. telarius* is known to occur in England, France, Germany, Norway, Sweden, Denmark, and Italy. American material has been determined at times by Banks as *T. telarius*, but the latter authority admits that he has not given the matter the critical analysis that present-day workers in the Tetranychidae have found to be necessary for the proper separation of species. The present author has never collected the linden mite in this country.

The description of the European *T. telarius* as compiled from accounts by European workers is as follows:

Length of female, 0.42 mm.; length of male, 0.33 mm. Color yellowish-greenish-yellow, sometimes green and with the hibernating females orange-yellow. A single eye cornea on each side. The body has the typical 13 pairs of bristles, of which those located in the hind half of the hysterosoma are the shortest; bristles not at all pilose; the two front vertex hairs are shorter than the hind ones; the hairs are fine, the longest of them being about one-third the length of the body. The collar trachea is V or U shaped and of about even thickness throughout. A transverse suture sharply separates the proterosoma from the hysterosoma, and immediately behind this line the body attains its greatest width. Leg I of male has empodium of same structure as the other pairs of legs. Empodial claw sometimes 6-cleft, but usually 4-cleft. Penis slender, the inner lobe rod-like; the basilar lobe obtusely sharp angled; the shaft somewhat thicker than inner lobe and is bent upward about 60° from the shaft axis to form the hook, which is acuminate pointed. Palpal "thumb" with stout terminal "finger," which at base is nearly as wide as tip of "thumb;" a pair of digituli at upper distal angle; a small dorsal "finger" midway to base than which the terminal "finger" is two and one-half times as thick, a pair of short hairs between dorsal "finger" and base; and a hair arising latero-ventrally from the middle of the "thumb." Hook of the penultimate joint just reaching to the dorsal "finger."

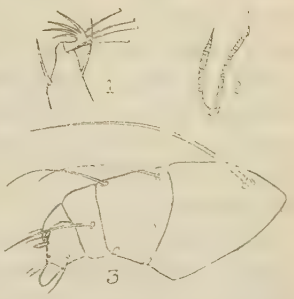

FIG. 3.—TETRANYCHUS TELARIUS LINNAEUS. 1, TARSAL APPENDAGES; 2, COLLAR TRACHEA; 3, PALPUS AND ITS APPENDAGES (AFTER TRÄGÅRDH).

TETRANYCHUS ALTHAEAE Von Hanstein.

Plate 79, fig. 8.

Tetranychus althaeae Von Hanstein, 1901, Zeitschr. wiss. Zool., vol. 70, pp. 58–108, pl. 6.

Von Hanstein (10) described this mite from material on hollyhock in Germany. His original description of *T. althaeae* was altogether too vague to be of much value taxonomically. We are therefore including Trägårdh's (18) revised diagnosis, which in substance is as follows:

Length of female, 0.570 mm.; of male, 0.430 mm. Body of female broadly oval, more reduced backwards than forward, and with a slight constriction between proterosoma and hysterosoma, the greatest width, 0.225 mm., is not at the shoulders, but nearer the middle. The legs are relatively longer in the male than with the female. The body hairs are finely pilose, quite pointed and short (about 0.09 mm.), not arising from elevations of the cuticule, and consisting of 13 pairs in the typical arrangement: frontal hairs only half as long as subfrontal ones. Pedipalps in both sexes with claw shorter than "thumb." Male palpus with claw small, slightly bent, and reaching very little onto the "thumb," which is sloping conical so that the dorsal line is longer than ventral line, and in the middle of the dorsal line with a small concavity. The seven typical appendages are present, including three hairs, two "fingers" and two digituli. The dorsal "finger" is only half as long and broad as terminal "finger," which is half as long as the fourth joint, cylindrical, three times as long as thick, and rounded at tip. The two digituli are somewhat longer than the terminal "finger" and are placed close together. Penis with a relatively stout and short shaft with a blunt point and with a slight prominence on the middle of the dorsal outline of shaft. (See plate 79, fig. 8.) Female pedipalp broader at base than in male, second joint about twice as long as third one; the terminal "finger" of the "thumb" is large, just equaling the ventral side of the fourth joint, cylindrical and rounded at tip; the digituli and hairs are similar to those of male. The tip of tarsus of female, with a strongly curved empodial claw, which is four-cleft beyond the angle, and four tenent hairs are borne on two enlarged pedicels at the sides of the claw base. The male tarsus bears an empodial claw that is very short, stout, and slightly bent, and is tripartite beyond the angle. The collar trachea extends straight down and is then bent in a round bow backward and upward without widening to a noticeable extent at any point.

TETRANYCHUS LUDENI Zacher.

Plate 79, fig. 10.

Tetranychus ludeni ZACHER, 1910, Mitth. Kaiserl. Biol. Anst. f. Land- und Forst., Heft 9, January.

A translation of Zacher's (13) text wherein he describes this species is as follows:

On *Salvia splendens*, *Solanum melongena*, and *Curcurbita*, St. Cloud, near Paris, April, 1912; Dahlem, 1911 and 1912. This species, concerning which I was able to report on a former occasion, occurred well into the winter in greenhouses. In January, however, the colonies perished, and I was therefore glad when I opportunely, during a visit to Paris, again found them in April in the greenhouse of Herr Ian I. Luden van Heumen. They occurred there in great numbers on *Salvia splendens* in the greenhouse and also in the forcing beds. Since we jointly studied the species there, and were able to establish its status as a new species, I therefore name the species in honor of my friend. In June I received from Herr Luden van Heumen colonies on *Salvia splendens* and *Curcurbita* which I reared through the entire summer and autumn in the greenhouse, for the observation of which, however, I did not have time. The species appeared spontaneously in great abundance on *Solanum melongena* in the greenhouse in scattered situations separated by several partitions. The structure of the claws agrees entirely with *T. telarius* L. The terminal "finger" of the palpus is clearly broader, the lateral "finger" somewhat farther distant from the base of the terminal "finger" than with *T. telarius* L. The penis [see pl. 79, fig. 10] deviates strongly. It is broader, only slightly curved, not hook-shaped. At the location of the angular projection in other species, there occurs a broad, rectangular projection. In color the species deviates strongly from *T. telarius* L. and other species, but the young larvae are red colored. It is a large species since the mature female measures 0.870 mm.

TETRANYCHUS FLAVUS Ewing.

Plate 79, fig. 4.

Tetranychus flavus EWING, 1913, Ann. Ent. Soc. Amer., vol. 6, p. 458.

The description according to Ewing is as follows:

General appearance similar to *T. borealis* Ewing; also similar to *T. telarius* Linn., but the individuals are smaller. Color of immature forms green or yellow; of adults green or yellow, with black markings not pronounced. Adults are never orange or red. In the winter when deprived of food supply all instars yellow. General structures similar to those of *T. telarius* Linn., but the tarsal claw in most instances is only five-cleft, the two inner prongs being united. In the case of the female of *T. flavus* the anal spines are situated farther forward than in *T. telarius* Linn., and also nearer the margins of the genital slit or opening. This species differs from *T. borealis* Ewing in the tarsal characters which are nearer those of *T. telarius* Linn., and in having no barb to the penis.

The penis of this species [see pl. 13, fig. 4] is entirely different from the penis of *T. telarius* Linn. It is long and spine-like. In length it is equal to a third or fourth of the entire length of the body. Inner lobe of penis not prominent, slightly swollen at its anterior end; in size, smaller than the basilar lobe of shaft. Shaft long, curved, and resembling the sting of a wasp; varying greatly in curvature, generally bending downward, then upward, or it may have but a single curve, or it might be straight. Basilar lobe large, subcylindrical, equal to one-fourth of the total length of the entire shaft. Hook and barb absent.

Ewing (15) writes that this species is a serious pest to apples in the Hood River Valley and the Willamette Valley, Oregon, and that it probably occurs throughout the Pacific Northwest above altitudes of 1,000 feet. He adds that "when fall comes and the trees drop their leaves, these mites all become a pale yellow in color, and collect in masses about the trunks of trees and the cracks of the ground for a region of several feet from the tree bases. Here they pass the winter, and become active again in the spring, when the trees put out their foliage."

TETRANYCHUS MULTIDIGITULI Ewing.

Tetranychus multidigituli EWING, 1917, Journ. Econ. Ent., vol. 10, October, p. 497.

Ewing's (22) original description of this species is as follows:

FIG. 4.—TETRANYCHUS MULTIDIGITULI EWING. PALPAL APPENDAGES (AFTER EWING).

Preserved specimens yellowish. Body somewhat depressed, skin more or less wrinkled, and abdomen somewhat pointed behind. Palpi prominent; claw strong and much curved; "thumb" stout, almost as broad as long, and not surpassing the claw; digit of "finger" about half as long as "thumb" and less than half as long as broad; digituli or spines, at least five near tip of "thumb," setae also present on "thumb." Mandibles or chelicerae, slender, with a simple loop toward base, and of uniform diameter except at base where they are slightly swollen. A single pair of eyes present, placed laterally; cornea strongly curved. Abdomen clothed above with rather stout, simple, slightly curved setae. Legs moderate; tarsus of leg 1 about one and one-third times as long as tibia, and truncate at its tip, from which springs a very long tactile seta. Tarsal claws rather weak, strongly curved near their bases, beyond which they are divided into six prongs. Onychium with four tenent hairs. Length, 0.30 mm.; width, 0.21 mm.

According to Ewing this species is described from several specimens on the bark of honey locust (*Gleditsia triacanthos*), collected by J. S. Houser. The author states that the "species differs from most of the other species in the genus in having several digituli, or setae, near the tip of 'thumb;' in having the setae of the body relatively short and of about the same length, and in having the tip of the tarsus broad and truncate."

TETRANYCHUS BIMACULATUS Harvey.

Plates 76, 79, fig. 11, and plates 80 and 81.

Tetranychus bimaculatus HARVEY, 1892 (1893), Ann. Rept. Maine Agric. Exp., Sta., p. 133.

?*Tetranychus vitis* BOISDUVAL, 1867, Entom. Horticole, p. 92.

Tetranychus desertorum BANKS, 1900, Tech. Bull. No. 8, Div. of Ent., U. S. Dept. of Agric., p. 76.

Tetranychus verbesinae COCKERELL, 1902, Nature, vol. 16, Oct., p. 608.

Tetranychus gloveri BANKS, 1900, Tech. Bull. No. 8, Div. Ent., U. S. Dept. Agric., p. 76.

Tetranychus opuntiae BANKS, 1908, Proc. Wash. Ent. Soc., vol. 10, p. 36.

The writer (23) published a list of 29 synonyms of the original European red spider (*T. telarius*) as claimed by various workers since Linnaeus. The studies that resulted in the elaboration of this extensive synonymy were, for the most part, probably not conducted with equipments of a nature satisfactory for the determination of the taxonomic characters. A further critical review of these species may bring to light additional synonyms of *T. bimaculatus*. Ewing (15) states that *T. telarius*, *T. bimaculatus*, *T. gloveri*, and *T. sexmaculatus* should be considered as synonymous.

The writer has had an opportunity to study very critically all of Banks's types, and has examined *bimaculatus* material collected by Harvey at Orono, Maine (type locality of same), as well as copious material of *sexmaculatus* from Florida. We are agreed with Ewing that *gloveri* and *bimaculatus* are the same, but our studies have demonstrated conclusively that *sexmaculatus* is distinct. Since Trägårdh (18), Zacher (13), and Berlese (5) of Europe state that *telarius* possesses but four empodial claws, and since Zacher's and Berlese's figures of the penis differ radically from that of *bimaculatus*, the writer prefers to consider the latter a distinct species, at least for the present.

T. vitis was described in 1867 by Boisduval (2) from mites on grape in France. The accompanying text figures of the palpus and mandibular plate, drawn from material collected and determined in France, are obviously identical with the corresponding characters of *bimaculatus*. The tarsal appendages also agree perfectly with those of *bimaculatus*. A study of Boisduval's type may corroborate this and cause *bimaculatus* to fall as a synonym of *vitis*.

A critical study of Banks's type slide (No. 7508) of *T. desertorum* reveals the fact that the tarsal claw is 6-cleft (not 4-cleft as claimed by Banks), and it otherwise agrees with that of *bimaculatus*. The palpal appendages of the former are also just like those of the latter, and this is true also with the mandibular plate.

A study of Cockrell's (11) type slide of *T. verbesinae* on *Verbesina exauriculata*, from Las Vegas, New Mexico, proves that the tarsal structure, as well as that of the mandibular plate, shape of body, arrangement of bristles and other characters, is quite like that of *bimaculatus*. Cockerell's description is so general that it might apply equally to any of the red spiders, and is of almost no taxonomic value.

Banks's type slide (No. 2330) of *T. gloveri* contains material that conforms perfectly with *bimaculatus*. The palpal appendages and the collar trachea are of the *bimaculatus* type, the tarsal claw is 6-cleft, and the mandibular plate is just as in the latter species.

An examination of Banks's type slide of *T. opuntiae* on cactus from Arizona reveals the fact that the palpal and tarsal characters are precisely as in *bimaculatus*. The empodial claw is 6-cleft, there is

a single eye cornea on each side, and the ratio of the frontal to subfrontal bristles is 3:5. The collar trachea appears about like that of *bimaculatus*.

In Banks's type collection there was a species that he had indicated as new and had given it the manuscript name *T. peruviensis*. It is well to record at this point that this species likewise agrees thoroughly with *bimaculatus* when subjected to a very close study.

At the time of publication of previous papers on *T. bimaculatus* by the writer a really ultramicroscopic examination with the aid of the oil immersion equipment (such as we have more recently adopted as the necessary standard) had not been made. Such intensive studies have since been conducted (see pl. 76, fig. 1), and I can corroborate Ewing's (17) description of the tarsal appendages wherein he says:

> Tarsal claw strongly curved at its base, * * * then divided into six pronglike elements * * * arranged in three pairs.

Description of female of *T. bimaculatus* Harvey:

Color variable; at times rusty green, sometimes greenish amber, or yellowish, at times almost black, but more often brick red or ferruginous red. Pigmented blotches occur almost invariably on the sides of the body, which are usually coalesced to form two large dark spots, one on each side extending from the back of the cephalothorax to the posterior region of the abdomen. These are often interrupted posteriorly to form a large anterior and a small posterior spot. These spots arise from underlying paired organs. Almost directly over coxae II are the carmine eyespots located on each side near the margin of the cephalothorax. Legs pale amber, much paler than ground color of body. Palpi pale salmon. Dorsal bristles pale, not arising from tubercles. Body pyriform oval, widest across posterior region of cephalothorax; bristles in four rows, each succeeding pair becoming shorter; the frontal pair a little over half as long as the subfrontal pair which, like the median pair next behind, are two-fifths the greatest width of body. Mandibular plate about twice as long as broad, tapering slightly forward, broadly rounded at tip, with a slight median notch. "Thumb" of palpus in shape somewhat like a truncated cone, the dorsal face about one-third longer than the greatest width at base, the upper surface twice slightly depressed transversely, with an intervening dilation, bearing on its tip a subcylindrical "finger" which is about two-fifths as wide at its base as the distal end of the "thumb." On its upper side, just above the "finger," are two stout, straight hairs arising close together, one medially and the other laterally, which do not greatly exceed in length the "finger." Near the middle of the upper side is a small "finger" three-fourths the length and one-half the width of the terminal "finger" and very similar to the latter. Between this dorsal "finger" and

the base of the "thumb" and at middle of latero-ventral aspect of "thumb" arises a hair about equalling the latter. The penultimate palpal joint bears the usual claw, which reaches about to the basal "finger," and also bears two bristles, one arising dorsally at base of claw which hardly equals the length of claw, and one arising near center of outer side which about equals the length of claw, and one arising near center of outer side which about equals the dorsal bristle. Legs I hardly equal the length of body from the anterior margin of cephalothorax to tip of abdomen; relative lengths of segments of leg I—coxa, 25; trochanter, 15; femur, 53; patella, 23; tibia, 30; tarsus, 49; femur almost four times as long as thick; tip of tarsus (the onychium) bearing a claw which is strongly arcuate and 6-cleft to its middle. Arising also from the onychium, lateral of base of claw on either side is an enlarged process which immediately splits into two nearly straight hairs, each of which bears a capitate tip. These four tenent hairs spread spokelike in the same plane and their respective lengths are similar to those of the fingers of the human hand viewed dorsally. A series of measured females gave the following dimensions: Length (front of cephalothorax to tip of abdomen), 0.424 mm.; width (across posterior margin of cephalothorax), 0.278 mm.; length of forelegs, 0.325 mm. (see pl. 76 and pl. 79, fig 11).

From Orono, Maine, on 37 species of cultivated plants by F. L. Harvey (7), who also reported it from Ithaca and New York and from West Grove, Pennsylvania.

TETRANYCHUS PACIFICUS, new species.

Plates 77 and 79, fig. 12.

Color, lemon-amber; spotted laterally from fecal contents of viscera. A single pale eye cornea on either side posterio-ventrad of subfrontal bristles. Legs and palpi pale. Dorsal bristles about 24, in four rows, appearing simple, pale, longest bristle (subfrontal) equaling breadth of body. Body elliptical, 0.39 mm. long by 0.215 mm. wide; vertical thickness of body about normal. "Thumb" of palpus of about usual length, a trifle longer than wide, bearing at its tip a subcylindrical "finger," the length of which is two and one-fourth times that of its thickness, and whose base is hardly one-half the width of "thumb" at tip; on its dorso-distal angle are two digituli; on dorsal face hardly midway to base is a "finger" or sensilla, in length just one-half that of terminal "finger," and between this and base are two short hairs barely exceeding the digituli; a hair arises latero-ventrally from the center of the "thumb;" the claw on the penultimate joint nearly reaches to the dorsal "finger." The spur on the second joint of the male palpus is conical and arises from a

flattened tubercle. The forelegs are about three-quarters the length of body. Femur three and one-half times as long as wide, about one-fifth longer than tarsus; tibia one-fifth longer than patella, which is two-thirds again as long as trochanter. Relative lengths of joints as follows: Trochanter, 9; femur, 33; patella, 15: tibia, 18; tarsus, 27. Tip of tarsus with empodial claw, which is strongly bent below its middle, and with distal two-thirds cleft into six equal spurs arranged in pairs. The usual series of four tenent hairs arise from the onychium at the sides of the empodial claw base. Collar trachea scythe-shaped, extends backward and downward, then bends sharply upward, of rather even caliber throughout. Penis (see pl. 79, fig. 12) nearest that of *T. bimaculatus* but very distinct in the nature of the barb; inner lobe slender, horn-like; basilar lobe projecting dorsally as a cone-shaped process; shaft not very stout, but somewhat thicker than inner lobe, bent upward to form an angle of about 90°: hook bearing a barb that is produced posteriorly into a spur nearly as long as the hook (see pl. 4).

Type.—Cat. No. 22292, U.S.N.M.

The type material is from Portland, Oregon, September 2, 1915, from mock orange (*Philadelphus gordonianus*), from *Vicia*, species, and from wild current (*Ribes*, species), and on chinaberry from Tracey, California, September 12, 1915, collected by the author. The species is nearest *T. bimaculatus*, from which it differs chiefly in the structure of the penis and of the collar trachea.

TETRANYCHUS BOREALIS Ewing.

Plate 79, fig. 9.

Tetranychus borealis EWING, 1913, Ann. Ent. Soc. Amer., vol. 6, p. 457.

In the original publication Ewing (15) states that the female is "similar to the female of *T. telarius* Linn., but smaller, and never orange or red. The inner prongs of the tarsal claw are stouter than the inner prongs of the tarsal claw of *T. telarius* Linn." Regarding the male he states it is "similar to the male of *T. telarius* Linn., except for penis. Penis long, straight. Inner lobe about equal to basilar lobe in length. Shaft shaped like a slender rod. Basilar lobe very pronounced, cone-shaped, equal to about one-fourth the length of the shaft. Hook absent. Barb knob-like." (See pl. 79, fig. 9.)

Ewing's type material was from *Spirea* species, from the Coast Range Mountains, Benton County, Oregon. Ewing states that this species is very closely related to *T. flavus* Ewing, but on account of the marked difference in the character of the empodial claws, and of the penis, the writer is of the opinion that the two species are rather widely separated.

TETRANYCHUS SEXMACULATUS Riley.

Plates 78 and 79, fig. 5.

Tetranychus sexmaculatus [1] Riley, 1890, Insect Life, vol. 2, p. 225.

The original description of *T. sexmaculatus* by Riley is as follows:

Length of the full-grown specimens, 0.3 mm. General color, pale greenish-yellow, marked on the abdomen with six or less small dusky spots. General shape oval, somewhat broadest in front of the eyes; laterally slightly constricted just opposite the eyes and at about the middle of the body, at which latter constriction the body is divided by a more or less distinct suture into two parts. There is often also a distinct though small tail-like projection at the end of the body. Anterior projection of cephalothorax rather short, somewhat conical, its apex rounded. Terminal joint of legs longest. Eyes, two each side, the anterior one of each pair being blood-red, this pigment extending some distance into the body giving the appearance of two red eyes on each side; the posterior eyes are colorless and transparent. The spots of the abdomen are arranged in two subdorsal rows, of three spots to each row; they are rounded and quite constant, especially in the smaller and more numerous specimens, though somewhat variable in the larger or full-grown mites.

In the mature specimens the anterior spots, which are arranged close to the dividing suture, are often composed of a collection of 8 to 12 larger or smaller, more or less circular, quite deep black spots, while in others all the spots are single, and with one or the other of the median pair wanting. In the smallest specimens these spots are either wanting or only the anterior or posterior pairs are present, the last pair in this case being generally largest and very distinct. The distribution of the hairs of the body is as follows: Two short slender hairs medially at anterior margin, directed forward, crossing each other near their tips; each side of these, also, close to margin, at about equal distances from each other and the lateral margin is a pair of transparent, circular pores, resembling those which usually give rise to a bristle. In front of the eyes and removed slightly toward the middle is, on each side, a row of rather long and stout bristles, the anterior pair being directed outward and slightly toward the head, and projecting beyond the lateral margin; the median pair are directed forward and cross each other near their tips. The third pair are longest, situated a little in front of the eyes and directed backward. Besides these stout bristles there is another smaller and slender hair not far from the lateral margin behind the eyes, and another at the margin in front of the eyes. The abdomen is provided on each side with a subdorsal row of three very long bristles, a more slender lateral row, four long dorsal bristles surrounding the end, and four ventral terminal bristles, of which the median pair is smallest.

The eggs are 0.11 mm. in diameter, globular, either colorless and transparent or very pale greenish-yellow, and are loosely attached to the web.

Riley's description is too general to be of much value taxonomically. Following is a condensed description from material on citrus leaves from Florida:

Body rhombic-elliptic; color lemon-yellow with blackish spots usually grouped in three blotches along each lateral region. A well-formed anterior and an abortive posterior eye cornea on each side. Subfrontal bristles about one and one-half times the length of the frontal bristles. Length of palpal "thumb" about equaling the width of the "thumb" at tip; dorsal "finger," digituli, and three hairs very similar to *T. bimaculatus*. Tarsal appendages consist of a strongly curved, 6-cleft empodial claw, and four tenent hairs—all resembling *T. bimaculatus*. Collar trachea pipe-

[1] In the original description Riley (4) designated the species name as *"6-maculatus,"* but later writers have adopted the *"sexmaculatus"* form of the word.

shaped, anterior arm slender, expanding and bending upward and backward into the short, conical posterior arm. Penis [see pl. 79, fig. 5] with slender inner arm, basilar lobe merely an obtuse prominence, shaft very similar in size and outline to inner lobe, tip obliquely truncate and produced ventrally into a very inconspicuous spur. Relative lengths of joints of foreleg as follows: Coxa 20, trochanter 9, femur 23, patella 12, tibia 13, tarsus 16 (see pl. 78).

This mite has done much to injure the citrus trees in Florida since 1886, according to Riley. Mr. W. W. Yothers tells me that the 6-spotted mite is most abundant in Florida during February and March. The species works in restricted colonies, causing severe yellow blistering of the leaf. When abundant, as is frequently the case, an alarming amount of defoliation of the citrus trees occurs.

TETRANYCHUS WELDONI Ewing.

Plate 79, fig. 6.

Tetranychus weldoni EWING, 1913, Ann. Entom. Soc. Amer., vol. 6, p. 457.

Ewing (15), in his original description of this species, says that for a long time he had confused this mite with *T. bimaculatus*, but that he had demonstrated that the males of the two species are quite distinct. Ewing's description of the species follows:

Female: Similar in all respects to the female of *T. telarius* Linn.

Male: Different from male of *T. telarius* Linn. in characters of penis and spur on palpus. Spur on palpus not so pointed as in *T. telarius* Linn. Penis very long, rod-like, equal to one-third the length of the body. Inner lobe short, rod-like, slightly swollen at its anterior end. Shaft rod-like, not setiform; gradually tapering as you pass backward; posterior one-half turned upward; tip narrowly rounded, not pointed. Basilar lobe absent. Hook absent. Barb absent. (See pl. 79, fig. 6.)

From Grand Junction, Colorado; on apple, prune, cottonwood.

TETRANYCHUS WILLAMETTEI McGregor.

Plate 79, fig. 1.

Tetranychus willamettei MCGREGOR, 1917, Proc. U. S. Nat. Mus., vol. 51, no. 2167, p. 586.

Color, pale lemon-yellow. Eyes single on each side. Legs and palpi, pale color. Dorsal bristles not arising from tubercles. Body of female elliptical, four-fifths again as long as broad, widest between legs III; length, 0.25 mm.; breadth, 0.14 mm. Bristles, about 22, in four dorsal rows, the longest about half the width of body. Mandibular plate with parallel sides, two and three-quarter times as long as broad, rounded at tip with no emargination visible. "Thumb" of palpus of very unusual form—semispherical or subconical, bearing at its tip a very slender, long "finger"; on its upper side near apex are two pin-shaped pseudo-fingers, and on same side about midway to base is a "finger" shorter and even thinner than terminal "finger"; between this and base are two slender hairs a trifle longer than subbasal "finger"; a slender hair arises latero-ventrally one-third the distance from tip to base of "thumb." The claw on the penultimate joint does not reach to subbasal "finger." The legs are rather short;

forelegs about four-fifths the length of body. Femur about two and one-half times as long as thick, barely longer than the tarsus; tibia and patella equal. Tip of tarsus bears a claw which is rather strongly bent near base and only slightly arched for the rest of its length; it appears to be uncleft for over half its length, and then divided into six closely appressed spines. The usual series of four tenent hairs arise in pairs by the side of the claw base. The collar trachea, opening medially in a pore, runs first downward and backward, then upward and backward, and then upward and slightly forward. It is of nearly even caliber throughout, but gradually enlarges a trifle toward the hind end. Viewed as a whole it is very nearly sickle-shaped. The penis (see pl. 79, fig. 1) is simple in structure, the shaft being very gradually attenuated to an extremely sharp point; it is very slightly bent just distad to the middle, but is generally straight.

Type.—Cat. No. 20169, U.S.N.M.

From Oregon City, Oregon, from the leaves of white oak (*Quercus lobata*), to which a noticeable rusty appearance is imparted through the work of the species.

TETRANYCHUS OREGONENSIS McGregor.

Plate 79, fig. 2.

Tetranychus oregonensis McGregor, 1917, Proc. U. S. Nat. Mus., vol. 51, no. 2167, p. 585.

Color, straw color or pale yellowish amber; lateral spots lacking or very inconspicuous. Eyes pale, a single one on either side near base of subfrontal bristles. Legs and palpi paler than body. Dorsal bristles 26, in four rows, plumose, pale, longest bristle (subfrontal) equal to half the breadth of body. Body elliptic-ovate, 0.304 mm. long by 0.142 mm. wide; vertical thickness of body greatly reduced. "Thumb" of palpus very short, nearly half again as wide as long, bearing at its tip a fairly ample "finger," whose base, however, is slightly more than one-third the width of "thumb" at tip. On its upper distal corner are two pseudo-fingers; on upper side hardly midway to base is a very small "finger" or sensilla, and between this and base are two short hairs; a pair arises latero-ventrally from the center of the "thumb." The claw on the penultimate joint reaches to the dorsal "finger." The spur on the second joint of the male palpus is rather long and tack-like. The legs are rather short, about three-fourths the length of body. Femur hardly twice as long as wide, equaling the tarsus; tibia one-fourth longer than patella, which barely surpasses the trochanter in length. Relative lengths of joints as follows: Trochanter, 10; femur, 21; patella, 11; tibia, 14; tarsus, 21. Tip of tarsus bears a claw which is strongly bent below its middle; the portion beyond this point is cleft into six nearly straight

claw divisions, the two inner of which are somewhat stronger than the others. The usual series of four tenent hairs arise by the sides of the claw base. Collar trachea of novel type; runs backward and downward as a straight, even-calibered tube, and then bends sharply upward into a short, wide chamber, the two arms making an angle with one another of less than 90°. The penis shaft (pl. 12, fig. 2) appears to taper gradually to a strong, unbarbed hook.

Type.—Cat. No. 20166, U.S.N.M.

From Portland, Oregon, on wild cherry (*Prunus*, species). Probably nearest *T. monticolus*, from which it is readily separated through the collar trachea and penis characters.

TETRANYCHUS MONTICOLUS McGregor.

Plate 79, fig. 3.

Tetranychus monticolus McGregor, 1917, Proc. U. S. Nat. Mus., vol. 51, no. 2167, p. 584.

Body of a rather uniform pale amber color. Eyes pale; one cornea on each side close behind the subfrontal bristle, behind which are the carrot-colored eyespots. Legs and palpi rather paler than body. Dorsal bristles colorless, distinctly plumose, 26 in four rows, the longest about five-ninths the width of body. Body pyriform-elliptic, usually widest between legs II and III. Mandibular plate nearly three times as long as broad, narrowed considerably anteriorly to a well-rounded, unemarginated tip. "Thumb" of palpus two-thirds as long as broad, bearing on its truncate tip a subconical "finger," whose base is only two-fifths as wide as the tip of the "thumb." On its upper distal corner are two pin-shaped pseudo-fingers, in length somewhat exceeding the terminal "finger," on upper side, about a third the distance to base, is a small "finger;" and immediately proximad to this is a short hair. Another similar hair occurs on the upper side just at base; a hair arises on the ventral aspect of the "thumb." The claw of the penultimate joint does not reach quite to the dorsal "finger." The legs are short, not much over two-thirds the length of body (exclusive of palpi). Femur a little more than twice as long as wide, not quite as long as tarsus; tibia a little longer than patella, which is five-sevenths again as long as the trochanter. Relative lengths of joints are as follows: Coxa, 8; trochanter, 7; femur, 20; patella, 12; tibia, 14; tarsus, 22. Tip of tarsus bears a claw which is bent near its middle and cleft into six slightly curved spurs. The customary four tenent hairs arise, two on either side by base of claw, tarsal claw of male differing from that of female in that its six divisions are much shorter and more abruptly acuminate. The collar trachea is rather novel; it runs downward

and backward from the pore, then turns suddenly upward and backward to form an angle of about 130°, and then the superior arm bends abruptly forward and upward, paralleling the inferior arm. The superior arm is much shorter and of somewhat smaller caliber than the inferior arm. The penis (pl. 79, fig. 3) is of unusual type. The short inner lobe is rod-like for most of its length and then expands suddenly to form the prominent basilar lobe; the outer shaft arises as a rod-like structure not materially stouter than the inner lobe, and for one-third its length is directed about continuous with the inner lobe, but bends slightly downward, then extending backward as a straight, slender spur, terminating in a very sharp point.

Type.—Cat. No. 20165, U.S.N.M.

From the south slope of Mount Hood, Oregon, above Government Camp, at an altitude of 6,000 feet, from underside of leaves of large-berried huckleberry (*Vaccinium*, species). Considerable discoloration and dropping of leaves accompanies the mite's activities. The species is rather close to *T. oregonensis*, but is readily distinguished from the latter through the marked difference in the form of the penis and collar trachea.

SEPTANYCHUS, new genus.

This genus at present represented by two species from the United States.

Tarsus with empodial claw separated at base from distal portion of tarsus; claw complex, appendiculate at or near base with four to six spurs; the dorsal spur decidedly shorter than the ventral group of spurs.

KEY TO SPECIES OF GENUS SEPTANYCHUS.

a¹. Terminal "finger" of palpal "thumb" in width at base exceeding its length; dorsal "finger" fully as long as terminal "finger;" mandibular plate converging to a well-rounded anterior margin.....*S. tumidus* Banks.

a². Terminal "finger" of palpal "thumb" about half again as long as wide; dorsal "finger" only about two-thirds the length of the terminal "finger;" mandibular plate with subparallel sides, and subtruncate frontal margin.

S. quinquenychus McGregor.

SEPTANYCHUS TUMIDUS (Banks).

Tetranychus tumidus Banks, 1900, Tech. Bull. No. 8, Div. of Ent., U. S. Dept. of Agric., p. 73.

The following description of *S. tumidus* is taken chiefly from Banks's (9) original paper, with such alterations as have been found necessary through a close study of the type material:

Dark red and somewhat pruinose, marked across the thorax with a dusky band, terminating each side in a rather large dusky spot, a similar spot on each side near end

of body; in some specimens there is an additional spot each side between the two legs and mouth parts pale reddish. Young specimens are paler, with spots more distinct and confluent. Eggs are pale red. Body moderately broad; bristles rather longer than usual, quite stout, all in the usual arrangement, subfrontal pair not twice as long as the frontal pair. Palpi of average length; "thumb" a trifle longer than greatest width, on its tip is a large, short, cylindro-conical "finger" whose base is over two-thirds the width of tip of "thumb," the usual dorsal "finger" arises at the middle of the dorsomedian line and is about one-third longer than the terminal "finger," but in thickness is barely more than one-third that of the latter; the two customary digituli arise at the outer distal angle of the "thumb," and the usual two hairs occur dorsally between the dorsal "finger" and the base; a hair arises near the middle of the outer face of the "thumb." Mandibular plate twice as long as broad, narrowed toward tip, the sides before tip slightly concave, broadly rounded at tip, without a median emargination. Legs moderate; femur I fully twice as long as broad; tibia I longer than patella; tarsus of moderate length, terminating in a claw which is strongly bent near middle, at which point arise two main divisions—the termino-dorsal division consisting of a single stout spur, and the ventral division of a somewhat stouter claw that soon splits into six equal, slender, spine-like spurs, which exceed considerably the dorsal spur.

FIG. 5.—SEPTANYCHUS TUMIDUS BANKS. 1, MANDIBULAR PLATE; 2, TARSAL APPENDAGES; 3, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

From Eustis, Florida, on the leaves of water hyacinth.

SEPTANYCHUS QUINQUENYCHUS (McGregor).

Tetranychus quinquenychus McGREGOR, 1914, Ann. Ent. Soc. Amer., vol. 7, no. 4, December.

There are a number of types of coloration, but the general ground-color is reddish-chestnut, with the cephalothorax decidedly paler; the prevailing design consists of two large lung-shaped blackish areas one on each side toward base of abdomen, which coalesce medially toward the front, a similar but smaller spot on each side near posterior end of abdomen; legs and mouthparts pale. Body broadest midway between legs II and III, tapering sharply forward to the narrow, slightly convex frontal margin, also tapering considerably behind, twice as long as broad; length, 0.45 mm., width, 0.23 mm.; bristles rather long and fine, seven each in the dorsal rows and six each in the sublateral rows, frontal pair half as long as subfrontal pair, which are placed just in front of the eyes. "Thumb" of palpus very short and stout—somewhat wider at base than the length, on its tip is a blunt "finger" the basal width of which is not greatly less than its length; midway on the upper side is a "finger" somewhat shorter than the terminal "finger" and of about one-third the width of the latter; at the upper distal angle are two digituli, and two short hairs occur on the "thumb" between the dorsal "finger"

and the antepenultimate claw. Mandibular plate with subparallel sides and subtruncate at front but unemarginated. Legs of moderate length; foreleg, 0.33 mm.; femur I, two and one-half times as long as broad; tibia I somewhat longer than patella I; tarsus in length equaling tibia and patella together; the tarsal appendages, consisting of the usual series of four tenent hairs and an empodial claw, which is very sharply bent at middle at which point arises dorsally a strong spur and ventrally a stronger division that immediately splits into six[1] equal, slender, distally-curving, spine-like claws which considerably exceed in length the dorsal claw. Relative lengths of the leg joints are as follows: Trochanter, 10; femur, 25; patella, 18; tibia, 19; tarsus, 37. There is but a single eye cornea on each side, which is set in a shallow submarginal socket directly over coxa II. Collar trachea scythe-shaped, the anterior arm running downward and backward with a slight upward convexity near its middle and then bending very sharply upward to form the nearly straight posterior arm, which is of similar caliber to the anterior arm. The spur on the male palpus consists of a spine-like appendage set in a thumb-like prominence of the second joint.

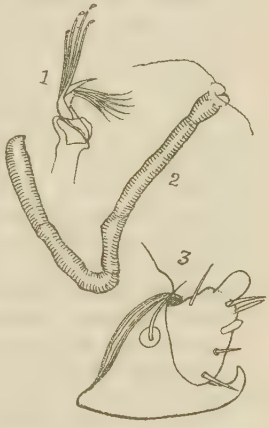

FIG. 6.—SEPTANYCHUS QUINQUENYCHUS MCGREGOR. 1, TARSAL APPENDAGES; 2, COLLAR TRACHEA; 3, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

Type.—Cat. No. 19087, U.S.N.M.

From Orlando, Florida, on castor bean (*Ricinus communis*). This species is rather close to the preceding species, but is probably distinct through the following characters: Breadth of body; relative length of frontal to subfrontal bristles; mandibular plate; proportions of terminal "finger." A more careful study of *tumidus* material may eventually show that the species is identical with *quinquenychus*.

Genus PARATETRANYCHUS Zacher.

Paratetranychus ZACHER, 1910, Mitth. Kais. Biol. Anst. f. Land u. Forst., Heft 9, Januar, pp. 37–41.

This genus contains at the present date two European species, one South American species, and seven North American species.

Red spiders, with empodial claw complex, appendiculate at base or at point between it and middle point with from 4 to 8 spurs; dorsal spur more prominent and much longer or at least equaling the appendiculate spurs; collar trachea straight, enlarged at end into a bladder-shaped chamber.

[1] In the original description the author erroneously writes that the ventral claw division splits into our spurs. We take this opportunity of correcting this statement as above recorded in the text.

Type.—*Paratetranychus ununguis* Jacobi, designated by Trägårdh, 1915.

KEY TO THE SPECIES OF GENUS PARATETRANYCHUS.

1. Appendiculate spurs at base of tarsal claw about one-quarter the length of the main dorsal claw division; femur I about half again as long as tarsus I; palpal "thumb" over twice as wide as long; terminal "finger" about half again as long as thick; mandibular plate deeply emarginate.....*P. peruvianus* McGregor.
   Appendiculate spurs at base of tarsal claw half or more the length of the main dorsal claw division..... 2
2. Main dorsal division of empodial claw decidedly exceeding the basal, appendiculate spurs; palpal "thumb" of male longer than wide..... 3
   Main dorsal division of empodial claw not conspicuously exceeding the basal appendiculate spurs; palpal "thumb" wider than long..... 4
3. Terminal "finger" of palpal "thumb" well developed, at base fully half as wide as tip of "thumb"; tarsal appendiculate spurs rather closely appressed and fused toward the bases; penis shaft stout, bent sharply to form acuminate hook; mandibular plate elongate, truncate or broadly rounded in front without emargination.....*P. pratensis* Banks.
   Terminal "finger" of palpal "thumb" of male inconspicuous, much less than half width of "thumb" at tip; tarsal appendiculate spurs widely radiate, free to their bases; penis shaft slender, together with acuminate hook forming sickle-shaped structure; mandibular plate wide, broadly rounded anteriorly without emargination.....*P. ununguis* Jacobi.
4. Terminal "finger" of palpus three times as long as thick, not over twice as thick as lateral "finger"; ventral tarsal claw division cleft barely more than half its length, and the six appendiculate spurs rather closely clustered; mandibular plate not plainly emarginate.....*P. modestus* Banks.
   Terminal "finger" of palpus not much longer than thick, from three to five times as thick as lateral "finger"; ventral tarsal claw division cleft nearly or quite to base, and considerably divergent; mandibular plate more often emarginate.....5
5. Mandibular plate not emarginate.....6
   Mandibular plate distinctly or indistinctly emarginate.....7
6. Terminal "finger" of palpal "thumb" spatulate in outline; lateral "finger" short, tack-like; main dorsal claw of tarsus with greatest thickness at mid-point. *P. pilosus* Canestrini and Fanzago.
   Terminal "finger" of palpal "thumb" subconic in outline; lateral "finger" long, banana-shaped; main dorsal claw of tarsus thickest at base.....*P. viridis*[1] Banks.
7. Dorsal bristles arising from prominent tubercles.....8
   Dorsal bristles not arising from prominent tubercles.....9
8. Tarsus equaling femur; mandibular plate almost imperceptibly emarginate; hook of penis longer than shaft, bent 60° from main axis of penis; tarsal claw with six appendiculate spurs; subfrontal bristles about three times as long as frontals. *P. citri* McGregor.
   Femur from one-quarter to one-fifth longer than tarsus; mandibular plate distinctly emarginate; hook of penis about half length of shaft, bent over 90° from main axis of penis; tarsal claw with five appendiculate spurs; subfrontal bristles only one-quarter again as long as frontals.....*P. ilicis* McGregor.
9. Femur about two and one-half times as long as wide and one-quarter again as long as tarsus; tarsal claw with six appendiculate spurs.....*P. bicolor* Banks.
   Femur about half again as long as wide and hardly equaling the tarsus; tarsal claw with five appendiculate spurs.....*P. yothersi* McGregor.

[1] *Viridis* and *simplex* are synonyms; the former was the earlier and holds.

PARATETRANYCHUS PERUVIANUS (McGregor).

Tteranychus (*Paratetranychus*) *peruvianus* McGregor, (*peruianus*) 1917, Proc U. S. Nat. Mus., vol. 51, pp. 581, 582, 589, pls. 101–107. The name was misspelled on p. 581, but properly spelled on p. 589.

Color, translucent yellowish-green. Eyes (in mounted material) clear, directly over front margin of coxae II. Dorsal bristles, 24 in number, not arising from tubercles, for the most part very short and weak, distributed on dorsal aspect of body in about the usual arrangement. Body of female rhombic-ovate, widest across hind margin of cephalothorax, which is slightly emarginate in front; male cuneate-pentagonal, widest across hind margin of cephalothorax, which is truncate in front, abdomen tapering to acute point posteriorly. Mandibular plate considerably more than twice as long as broad, margins subparallel, with a very distinct anterior emargination. "Thumb" of palpus very short in proportion to its width, bearing at its tip a relatively large, subconical "finger," whose base is half as wide as tip of "thumb," length of "thumb" and terminal "finger" together equaling width of "thumb." On its rather truncate tip, on opposite sides of the "finger," are two stout spines or pseudo-fingers (not much thicker than hairs); on upper side about one-third to base, is a small "finger," and between this and base are two short hairs, the distalmost one of which appears to arise adjacent to the small "finger." The claw on the penultimate joint reaches far beyond the middle of the "thumb"; a hair arises laterally from the center of the "thumb," and another from a similar position on the penultimate joint. The legs are unusually short, in the female distinctly less than the width of the body, in the male barely exceeding the width of body. Femur I considerably less than twice as long as wide, about half again as long as tarsus I. Tibia I just equaling patella I, which barely equals trochanter I. Tip of tarsus bears a stout, sickle-shaped claw, which is uncleft to its tip; arising from the under face of this claw, near its base, are six weak spines, which are less than one-fourth of the length of the main claw. The usual series of four tenent hairs arise by the sides of the base of the claw from the tip of the short onychium. The egg is unknown to the writer.

Type.—Cat. No. 20164, U.S.N.M.

The type material was collected by Mr. E. W. Rust "along the line of the Ferrocarril Central del Peru near La Legua (between Lima and Callao), Peru, South America, January, 1913, from the underside of willow (*Salix*, species) leaves."

Notes.—An ample series of measurements of mounted material in fair condition yielded the following averages for adults of both sexes:

Sex.	Length (not including palpi).	Width.	Foreleg.
	mm.	*mm.*	*mm.*
Female	0.299	0.205	0.173
Male	.237	.168	.177

The relative lengths of the leg joints are as follows: Coxa, 9; trochanter, 10; femur, 16; patella, 9.5; tibia, 9.5; tarsus, 10.

Mr. Rust states that the presence of this species causes the willow leaves to turn yellow and drop, but did not appear to greatly injure the trees. He says that the individuals live in restricted colonies under small, compact webs which almost completely conceal them. These webs, according to Mr. Rust, resemble very much the webs under which many true spiders deposit their eggs. No predaceous species were observed in the mite colonies.

PARATETRANYCHUS PRATENSIS (Banks).

Plate 79, fig. 16.

Tetranychus pratensis BANKS, 1912, Proc. Wash. Entom. Soc., vol. 14, p. 459.

Owing, undoubtedly, to inadequate microscopic equipment, Banks (14), in his original description of this species, entirely misstated the characters of the tarsus and palpus. Recent critical studies of the type material have revealed the fact that instead, as Banks states, of the tarsus ending "in two long, simple, and but little curved claws," it bears a single sickle-shaped claw, which gives rise near its base to six appendiculate spurs. Ewing writes that "the inner claw is bent downward very near its base, and beyond this bend it is three-cleft." Also the palpal "thumb," in addition to bearing "one stout finger and a hair at one corner," possesses the usual dorsal "finger," two digituli at the upper distal corner, and two short hairs dorsally between the dorsal "finger" and base. The original description as modified through the results of recent studies of the type material is as follows:

Pale greenish. Body nearly or quite twice as long as broad, rather more elongate than usual, broadly rounded behind, without humps above, with the usual four rows of rather long bristles, those above longer than the hind tarsi. Legs short, none as long as the body, with many long hairs, some extremely long, being as long as two joints together. Mandibular plate elongate, truncate, or broadly rounded in front, but not emarginate. Palpal "thumb" a

little longer than wide, bearing at its tip a well-developed "finger," whose base is about one-half the width of "thumb" at tip. On upper distal corner of "thumb" are two digituli about half again as long as terminal "finger." On upper side, barely midway to base, is a slender "finger" or sensilla only one-third as thick as the terminal "finger," and between this and base are two short hairs. A hair arises latero-ventrally from the center of the "thumb." The claw on the penultimate joint is about as usual. Tip of tarsus bears a very strong, sickle-shaped claw, which is uncleft to its tip. At a point one-fifth its length from the base there arises from the ventral surface six slender spurs in length about two-fifths that of the claw. The usual series of four tenent hairs arise by the sides of the base of the claw. Body length, 0.4 mm. According to Ewing the form of the penis (see pl. 79, fig. 16) is as follows: "Inner lobe slightly over one-half as long as the shaft of the penis. Shaft stout, somewhat similar to the shaft in *T. telarius* Linnaeus; enlarged slightly at its base, so as to form the basilar lobe. Hook pronounced; bent at an angle of about 90° to the axis of the shaft. Barb absent."

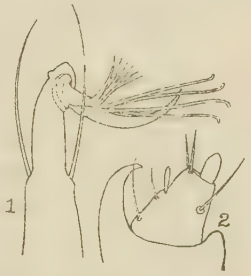

FIG. 7.—PARATETRANYCHUS PRATENSIS BANKS. 1, TARSAL APPENDAGES; 2, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

From Pullman, Washington, on timothy, in June. G. R. Hyslop, coll.

PARATETRANYCHUS UNUNGUIS (Jacobi).

Plate 79, fig. 13.

Tetranychus ununguis JACOBI, 1905, Naturw. Zeitschr. Land-u., Forst. p. 239.

Color greenish-yellow, abdomen black mottled through the visibility of the excrementary mass. One very long, slender tarsal claw with six widely appendiculate spurs, which are free to their bases, arising ventrally from a protuberance at the base of the claw. Body bristles pointed, not arising from tubercles. Mandibular plate wide, broadly rounded anteriorly without emargination. Penis shaft slender, (see pl. 79, fig. 13) together with acuminate hook, forming a sickel-shaped structure. Eggs round, dark-red, deposited on bark, bud scales, and needles.

In 1905 Jacobi (12) placed this European species under the then all-inclusive genus *Tetranychus*, but in 1910 Zacher (13) erected the genus *Paratetranychus* to include *P. ununguis* and *P. pilosus* Canestrini and Fanzago, based on the tarsal and collar trachea characters. *P. ununguis* was described by Jacobi from material on conifer needles collected at Dahlem, Germany. The preferred hosts were *Picea sitchensis* and *P. excelsa*, of which 30 per cent of the trees were attacked.

PARATETRANYCHUS MODESTUS (Banks).

Tetranychus modestus BANKS, 1900, U. S. Dept. Agric., Div. Entom., Tech. Ser. No. 8, p. 73.

It is necessary to revise radically Banks's (9) original description of this species. He writes that the tarsus "ends in a long simple claw," and that the palpal "thumb" is not as long as claw, with three nearly equal fingers on the tip. A critical study of the type material reveals the fact that the tarsal claw is not simple but possesses a series of six appendiculate spurs, while the palpal "thumb" actually considerably exceeds the claw, and only the one usual terminal "finger" occurs on the "thumb," as well as the customary two digituli. A revision of the original description based on a careful study of the type material is as follows:

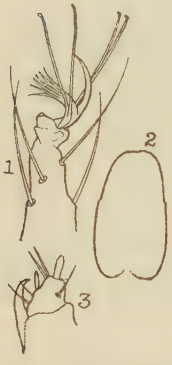

FIG. 8.—PARATETRANYCHUS MODESTUS BANKS. 1, TARSAL APPENDAGES; 2, MANDIBULAR PLATE; 3, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

Head, palpi, and legs are brownish; the body yellowish, with quite large blackish irregular spots across middle of thorax; a large lateral spot in region of last pair of legs; and a broad irregular border around end of body. Body rather more elongate than usual; bristles in the usual arrangement. Legs short; femur I fully twice as long as broad; tibia I only a trifle longer than patella I; tarsus short, ends in a large, uniformly curved, acuminate claw, which is uncleft to its tip; arising ventrally from this claw, at a point one-quarter its length from the base, are six closely clustered appendiculate spurs which are two-thirds the length of the main claw and fused for about half their length. The usual series of four tenent hairs arise by the sides of the base of the claw from the tip of the onychium. Mandibular plate of moderate length, not much narrowed toward tip, which is broadly rounded. Palpi short, "thumb" a trifle wider than long, bearing at its tip a slender "finger" three times as long as thick whose base is less than half as wide as tip of "thumb." On its upper distal corner are two digituli one-half again as long as the terminal "finger," on upper side barely halfway to the base is a smaller "finger" a trifle over half the thickness of the terminal "finger," and between this and base are two short hairs. Another similar hair arises latero-ventrally near the center of "thumb." On each side of the anal opening there is a pair of fine hairs.

Found in August at Washington, District of Columbia, causing a rustlike appearance on the blades of corn.

PARATETRANYCHUS PILOSUS (Canestrini and Fanzago).

Plate 79, fig. 14.

Tetranychus pilosus CANESTRINI and FANZAGO, 1877–78, Intorno agli Acari Italiani, Atti Ist. Venet., ser. 5, vol. 4, pp. 69–208.

Canestrini and Fanzago (3) in 1878 referred this species to the genus *Tetranychus*, but Zacher (13), in 1910, as before mentioned, erected the genus *Paratetranychus* to include *P. ununguis* Jacobi and *P. pilosus*. *P. pilosus* is called the rose mite in Italy and occurs there most commonly on roses, *Ribes*, species, pear, and cherry.

Length of female, 0.315 mm. Dorsal bristles, 26, in four rows, fine-pointed, pilose, and arising from tubercles. Palpal "thumb" bears on its tip a stout spatulate "finger," the thickness of which about equals its length. The usual dorso-terminal digituli, the dorsal "finger" which is tack-like, and the dorso-basal hairs occur on the "thumb," as well as the latero-ventral hair. The tarsus possesses a heavy, sickle-shaped claw which is thickest at mid-point; from this middle point ventrally four appendiculate spurs arise which considerably surpass the claw. The usual four tenent hairs are present. The inner lobe of the penis (see pl. 79, fig. 14) is club-shaped, thickening considerably posteriorly to form the obtuse basilar lobe; the shaft barely half as long as inner lobe but otherwise similar; hook bent only 45° from the main axis of the penis, sharply acuminate without barb. Collar trachea straight and of even caliber, with spherical, dilated chamber. Mandibular plate narrowed and rounded anteriorly, but not emarginate.

PARATETRANYCHUS VIRIDIS (Banks).

Tetranychus viridis BANKS, 1894, Trans. Amer. Entom. Soc., vol. 21, p. 218.
Tetranychus simplex BANKS, 1914, Pomona Journ. Ent. Zool., vol. 6, no. 2, p. 57.

Banks's (8) description of *P. viridis*, which follows, is in the most abstract terms and in no way differentiates the species from the red spiders:

Length, 0.40 mm. Greenish, with a large, blackish or sometimes reddish spot each side covering the shoulders of the abdomen and the posterior angles of the cephalothorax. The cephalothorax is quite distinctly separated from the abdomen by a constriction; the abdomen broadest at the shoulders; the cephalothorax short, broadly rounded. The body bears a few long bristles. Those on the legs are similar, but shorter. The anterior pairs of legs are somewhat larger than the posterior pairs.

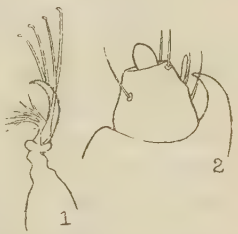

FIG. 9.—PARATETRANYCHUS VIRIDIS BANKS. 1, TARSAL APPENDAGES; 2, PALPAL "THUMB" AND ITS APPENDAGES (ORIGINAL).

A critical study of Banks's material reveals the following tarsal and palpal characters:

Tip of tarsus bears a short, sickle-shaped claw, which is uncleft to its tip; arising from the ventral surface of this claw, one-fifth its length from base, are six radiating spurs, which are about half the length of the main claw. The usual series of four tenent hairs arise by the sides of the base of the claw from the tip of the onychium. "Thumb" of palpus short, wider than long, bearing at its tip an unusually ample, oval-shaped "finger," which is almost as thick as long, and whose base is just half as wide as tip of "thumb." Near the upper distal angle are the two customary digituli which slightly exceed the terminal "finger;" on upper side not quite midway to base is a small, banana-shaped "finger" or sensilla one-fifth the thickness of the terminal "finger," and between this and base of "thumb" are two short hairs; a hair arises latero-ventrally from the center of the "thumb." The claw on the penultimate joint reaches to the dorsal "finger." Neither the penis nor the collar trachea could be discerned in the preserved material.

Type material from the upper side of pecan leaves, Texas.

It has developed from a study of the type material that Banks's species *T. simplex* is identical with *P. viridis*, and is herewith reduced through the operation of the priority rule.

PARATETRANYCHUS CITRI (McGregor).

Plate 79, fig. 15.

Tetranychus (*Paratetranychus*) *citri* McGregor, 1916, Ann. Ent. Soc. Amer., vol 9, no. 3, pp. 284–288, pl. 2.

Tetranychus mytilaspidis Banks not Riley (*Penthalodes*), 1900, U. S. Dept. Agr., Div. Ent., Tech. Ser., Bull. 8, p. 71.

As pointed out in a paper by the present writer (20), the citrus mite had never been described prior to that time. Banks had interpreted Riley's type material of *Penthalodes mytilaspidis* to be the citrus mite which we have shown was clearly not the case.

Distinctly velvety-red in color. In size larger and more obese than the majority of red spider species. Female: Length, 0.305 mm.; width, 0.230 mm. A single eye cornea on each side, twice as far behind the subfrontal bristle as the latter's distance from the frontal bristle. Dorsal bristles long, stout, arising from prominent tubercles subfrontal bristles barely three times as long as frontals; bristles sparsely pilose. Legs paler than body color, bristles arranged chiefly in four longitudinal rows. Mandibular plate abruptly narrowed anteriorly, tip rounded, usually with an almost imperceptible emargination. Palpus is provided with a comparatively short "thumb," bearing a terminal, slightly clavate "finger" whose base is less than half the width of tip of "thumb;" with two pseudo-fingers arising on either side of the upper distal corner, which are not greatly thicker than hairs; on upper side hardly midway to base with a small "finger" between which and base are two short, stout hairs; near the lower center of the outer side of "thumb" with a hair

which reaches to the tip of the terminal "finger;" with the claw on the penultimate joint stout and reaching to the dorsal "finger;" a strong hair arising laterally from the center of the penultimate joint, another arising from the center of the dorsal face of this joint which equals the claw, and a short weak hair with its origin on the inner base of claw; and with a very strongly tubercled spur arising distally from the top of the antepenultimate joint of the male. The legs are relatively short; femur somewhat more than twice as long as wide, barely equaling tarsus; tibia a little longer than patella which is one-third again as long as trochanter: Relative lengths of joints are as follows: Coxa 11, trochanter 11, femur 29, patella 15, tibia 17, tarsus 29. Tip of tarsus bears a claw which is rather straight for two-thirds its length and then bent sharply downward; at a point one-third the length of the claw from its base arise six slightly curved spurs whose tips surpass that of the main claw; the four usual tenent hairs arise two on either side of the base of the claw.

The male is considerably smaller than the female (length, 0.216 mm.; width, 0.146 mm.), abruptly narrowed posteriorly. The legs appear longer in proportion to the body than in the case of the female, and are salmon-pink. The distribution of dorsal bristles is similar to that of female. Penis (see pl. 79, fig. 15) comparatively short; inner lobe long, rod-like, about three times as long as the shaft; shaft very stout and short, becoming abruptly smaller distally, and bent upward at an angle of 120° to form the attenuate hook,which is considerably longer than the shaft; basilar lobe present on upper side of shaft as a strong, conical projection; hook possessing no barb, being spine-like terminally.

The egg when first laid is pale, almost colorless, like a drop of honey, but later turns bright red, is sphero-lenticular, with a vertical stalk arising from the center of the top side which in length is about twice the diameter of the egg. Several guy fibrils radiate downward from the apex of the stalk to the leaf surface, thus giving additional attachment to the egg.

Type.—Cat. No. 20362, U.S.N.M.

The type material is from Orlando, Florida, March 7, 1916, from the leaves of lemon, collected by W. W. Yothers.

PARATETRANYCHUS ILICIS (McGregor).

Plate 79, fig. 17.

Tetranychus ilicis McGregor, 1917, Proc. U. S. Nat. Mus., vol. 51, pp. 581–590, pls. 101–107.

Color, from ferruginous to reddish-brown, with a pale pink area embracing central portion of the cephalothorax; darker than most red spider species. Eyes conspicuous, carmine. Dorsal bristles

colorless, arising from rather prominent tubercles, densely clothed with distally pointing barbules; subfrontal bristle one-fourth again as long as frontal one. Body of female rotund-elliptical, length, 0.302 mm.; width, 0.259 mm. Male much less rotund, narrowed backward; length, 0.237 mm.; width, 0.184 mm. Bristles about 22 in four rows, in length averaging about five-sevenths the width of body. Mandibular plate three-fourths again as long as wide, narrowed somewhat anteriorly to a rotund tip, which is distinctly emarginate in the female. Palpi pale pink, like cephalothorax. "Thumb" of palpus not greatly shortened axially, the thickness at middle being about one-fifth in excess of its length, bearing at its tip a slightly clavate "finger," whose base is less than half as wide as the tip of "thumb;" on its upper distal corner are two spine-like pseudo-fingers; on upper side almost midway to base is a greatly reduced "finger," about one-fourth as thick as the terminal "finger," and between this and base are two short stout hairs rather similar to the pseudo-fingers. A hair, similar to the upper basal one, arises laterally from the center of the "thumb." The claw of the penultimate joint reaches just beyond the dorsal "finger." The legs are pale amber-color, not quite as long as width of body. Femur three and one-half times as long as wide, somewhat exceeding tarsus. Tibia nearly a third longer than patella, which is nearly twice the length of the trochanter. Tip or tarsus bears a stout claw, which is sickle-shaped; six slender spurs, which are free to their bases, arise perpendicularly from the claw a short distance from its base. The usual series of four tenent hairs are present, two on each side fusing to form a swollen pedicel, which are set on the onychium on either side of the main claw base. Relative lengths of leg joints as follows: Coxa, 15; trochanter, 7; femur, 26; patella, 12; tibia, 15; tarsus, 23. The collar trachea, opening medially in a pore, runs downward in an almost straight line, and just above the ventral end bends sharply backward and expands into an elliptical chamber, which is twice the caliber of the linear portion.

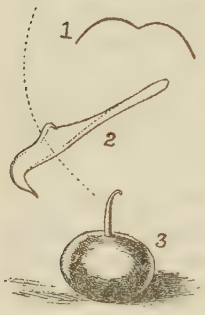

FIG. 10.—PARATETRANYCHUS ILICIS McGREGOR. 1, TIP OF MANDIBULAR PLATE; 2, PENIS AND HIND BODY MARGIN; 3, EGG (ORIGINAL).

Penis (see pl. 79, fig. 17) appears to be intermediate between the *Tetranychus bimaculatus* type and that of *T. monticolus*. The inner lobe is rod-like, slender, and over twice as long as the shaft; a well-developed basilar lobe occurs dorsally; the shaft is comparatively short and thick and is bent abruptly downward at an angle of over 90° from the main axis of the penis to form the stout hook; the hook is about one-half the length of the shaft, and terminates in a rather straight, unbarbed, very sharp spur.

The egg is slightly depressed globose, and bears a recurved stalk which about equals the height of the egg.

Type.—Cat. No. 20167, U.S.N.M.

The type material is from Batesburg, South Carolina, January 6, 1916, from the upper and under sides of American holly leaves (*Ilex opaca*), collected by Mr. F. L. McDonough and the author. The present species bears some likeness to Trägårdh's genus *Schizotetranychus* in the presence of two main divisions of the tarsal claw.

PARATETRANYCHUS BICOLOR (Banks).

Tetranychus bicolor Banks, 1894, Trans. Amer. Ent. Soc., p. 218.

The following original description of the species by Banks is so abstract as to be of almost no taxonomic value:

Length, 0.35 mm. Cephalothorax pale; abdomen dark red, the anterior edge of the red with a median and lateral projections; legs pale yellowish; eyes red; bristles white; Sometimes there is a light dorsal streak on the abdomen. Body elliptical, pointed in front. Cephalothorax with four long bristles; abdomen with a submedian row of five and an outer row of four bristles. All the bristles arise from small, circular depressions. Legs short, subequal, hairy. The male has the abdomen more pointed than in the female, otherwise similar.

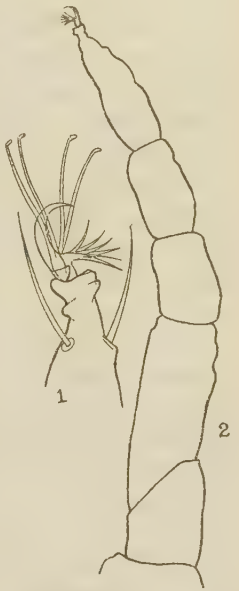

Fig. 11.—Paratetranychus bicolor Banks. 1, tarsal appendages; 2, foreleg showing relative lengths of joints (original).

The following diagnostic characters of real taxonomic importance were determined through a critical study of the type material:

Tarsus ending in a very strong, sickle-shaped claw, which is uncleft to its tip; arising from the ventral surface of the claw, one-fifth its length from its base, are six diverging spurs, the proximal one of which is the strongest, which in length are three-fifths that of the main claw. The customary four tenent hairs arise, two on each side at the base of the claw from the tip of the onychium. "Thumb" of palpus bears an ample "finger" terminally which is nearly as wide as long, and the base of which is three-fifths as wide as tip of "thumb"; two strong digituli arise at the dorso-terminal angle, and the dorsal "finger," which is only one-fourth the thickness of the terminal "finger," arises midway to the base; a pair of short hairs occur dorsally between the dorsal "finger" and the base, and a similar hair arises latero-ventrally near the middle of "thumb." Foreleg a trifle longer than width of body. Femur I about two and one-half times as long as wide, and one-fourth again as long as tarsus; tibia a little longer than patella, which barely

exceeds the trochanter, relative lengths of leg joints as follows: Trochanter 13, femur 29, patella 14, tibia 16, tarsus 23.

Type material on upper side of oak and chestnut leaves, woods near Sea Cliff, New York. Other specimens from oak at Washington, District of Columbia, and from Geneva, New York, on a Norway spruce hedge. This species is very close to *P. yothersi*.

PARATETRANYCHUS YOTHERSI (McGregor).

Tetranychus yothersi McGregor, 1914, Ann. Ent. Soc. Amer., vol. 7, no. 4, December.

Predominating color a rusty-red, arising mainly from large intestinal structures occurring on each side and connected centrally by a narrow isthmus, a shield- or saddle-shaped pale pinkish-amber area includes most of the cephalothorax; a narrow clear or translucent area extends medially from behind almost to the thoracic suture. Eyes crimson, each set at inner border of a groove overlying coxae I and II. Coxae and femora of a greenish hue; tibia I and tarsi I salmon-color. Palpi salmon-color. Dorsal bristles colorless, not arising from tubercles. Body of female sphero-elliptical, widest equatorially; male subcuneate, widest across cephalothorax, which is somewhat truncate in front, abdomen tapering to acute point posteriorly; bristles in four rows, averaging in length two-fifths of the width of the body. Mandibular plate less than twice as long as broad, somewhat tapering anteriorly with a distinct emargination. "Thumb" of palpus much reduced longitudinally, bearing at its tip a relatively large, slightly clavate "finger" whose base is almost as wide as the tip of the "thumb"; on its upper distal corner are two pseudo-fingers, not greatly thicker than hairs; on upper side about midway to base is a small "finger," and between this and base are two short, stout hairs; the claw on the penultimate joint reaches to the middle of the "thumb"; a hair arises laterally from the center of the "thumb," and another from a similar position on the penultimate joint. The legs are relatively short, barely as long as width of body; femur only half again as long as wide, hardly equaling tarsus; tibia a trifle longer than patella, which equals the trochanter; tip of tarsus bears a claw which is nearly straight for two-thirds its length and then bent to nearly a right angle; a second claw, arising from the other at its point of origin from the onychium, is almost straight and forms with the first an obtuse angle; four strong spurs (corresponding to the usual 4-cleft claw) have their origin in common with the claws; the usual series of four tenent hairs arise by the sides of the claws from the tip of the onychium.

The egg is globose-lenticular and bears a stalk which varies in development from a length equaling the height of the egg to a mere

rudimentary papilla; guy fibrils are occasionally seen connecting the egg with the leaf; the color is smoky-amber.

Type.—Cat. No. 19088, U.S.N.M.

The type material is from Orlando, Florida, August 28, 1914, from the uppper surface of camphor leaves, collected by W. W. Yothers.

An extensive series of measurements of material on Eucalyptus and camphor from Florida, and on oak, elm, and pecan from South Carolina have yielded the following averages:

Adults.

	Length (not including palpi).	Width.	Foreleg.
	mm.	*mm.*	*mm.*
Female..	0.307	0.237	0.232
Male.....	.225	.152	.222

Egg.

Diameter.	Height.	Stalk (when well developed.
mm.	*mm.*	*mm.*
0.127	0.082	0.077

NOTES.

It is of interest to record that, whereas the common red spiders have long been known to feed almost exclusively on the under surface of the leaf, this species confines its activities entirely to the top of the leaves.

To date the species has been recorded upon camphor (*Camphora officinale*) and *Eucalyptus*, species at Orlando, Florida, avocado at Miami Beach, Florida, and upon two varieties of elm, the willow oak (*Quercus phellos*), the white oak (*Quercus alba*), and the pecan at Batesburg, South Carolina. Mr. Yothers says that at certain times it is everywhere present on the camphor tree, causing a reddening of the leaves and reduced vitality of the tree.

The species is exceedingly abundant certain seasons in North and South Carolina on the foliage of the small-leaved elm (*Ulmus americana*), to which it imparts a rusty appearance. In spite of the exposure of this species on the top of the foliage very little control seems to be exerted through rains. This may be accountable through the possession by the species of the strongly hooked tarsal claws which character also holds in the case of *P. ilicis*, another species that frequents the top side of leaves.

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EXPLANATION OF PLATES.

PLATE 76.

Tetranychus bimaculatus Harvey.

Fig. 1, tarsal appendages in profile; fig. 2, tarsal appendages viewed dorsally; fig. 3, collar trachea; fig. 4, penis; fig. 5, male palpus and its appendages; fig. 6, palpus of female. Figs. 1 and 2 are from material from Orono, Maine.

PLATE 77.

Tetranychus pacificus, new species.

Fig. 1, collar trachea; fig. 2, foreleg viewed laterally; fig. 3, penis; fig. 4, tarsal appendages; fig. 5, palpus and its appendages.

PLATE 78.

Tetranychus sexmaculatus Riley.

Fig. 1, left foreleg, viewed ventrally; fig. 2, tarsal appendages; fig. 3, eye corneae of right side, viewed from above; fig. 4, outline of body to show six typical spots from which the species derives its name; fig. 5, frontal and subfrontal bristles; fig. 6, palpal appendages; fig. 7, collar trachea; fig. 8, penis.

PLATE 79.

Showing variations of the penis of such species for which this structure is known.

Fig. 1, *Tetranychus willammettei* McGregor; fig. 2, *T. oregonensis* McGregor; fig. 3, *T. monticolus* McGregor; fig. 4, *T. flavus* Ewing; fig. 5, *T. sexmaculatus* Riley; fig. 6, *T. weldoni* Ewing; fig. 7, *T. telarius* Linnaeus; fig. 8, *T. althaeae* von Hanstein; fig. 9, *T. borealis* Ewing; fig. 10, *T. ludeni* Zacher; fig. 11, *T. bimaculatus* Harvey; fig. 12, *T. pacificus*, new species; fig. 13, *Paratetranychus ununguis* Jacobi; fig. 14, *P. pilosus* Canestrini and Fanzago; fig. 15, *P. citri* McGregor; fig. 16, *P. pratensis* Banks; fig. 17, *P. ilicis* McGregor.

(Figs. 1, 2, 3, 5, 11, 12, 15, and 17 drawn from type or authentic material by the author; figs. 4, 6, 9, and 16 drawn from Ewing's descriptions; fig. 7 drawn from Berlese's figure; figs. 8, 13, and 14 after Trägårdh; fig. 10 after Zacher).

PLATE 80.

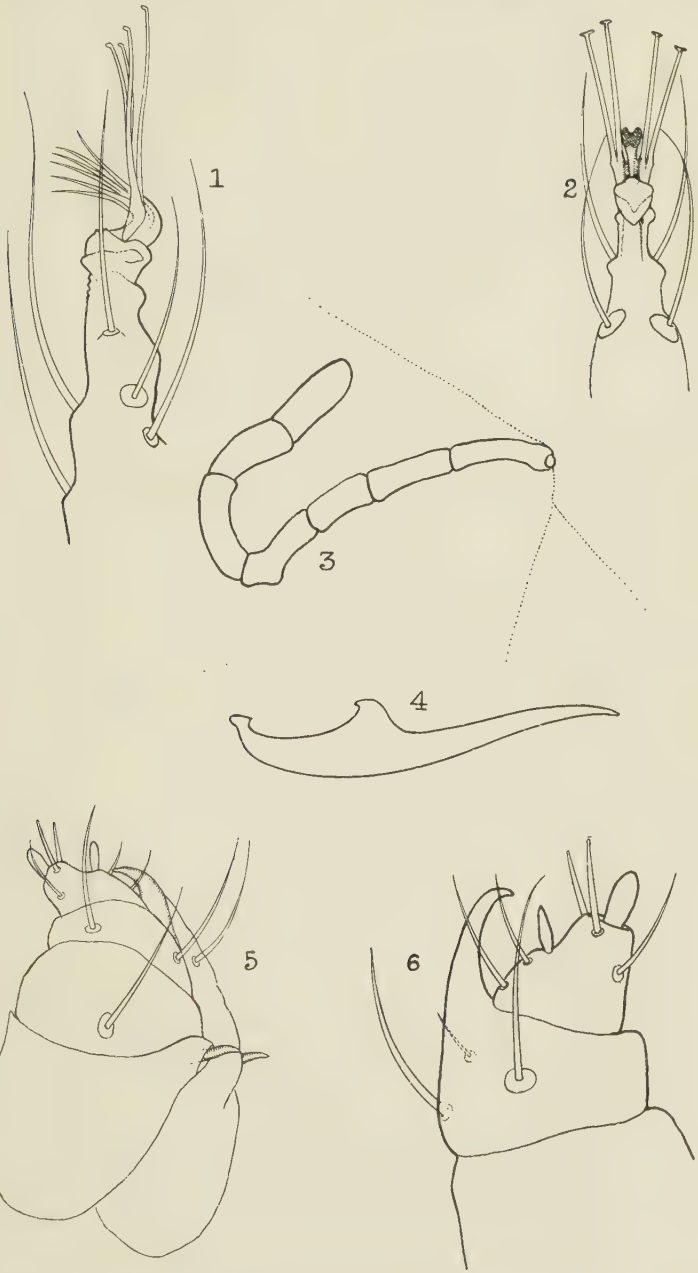
Work of *Tetranychus bimaculatus* Harvey on cotton leaves.

Fig. 1, incipient attack resulting in a single local discoloration spot; fig. 2, advanced work of red spiders resulting in the distortion and discoloration of entire leaf and ultimate defoliation of plant.

PLATE 81.

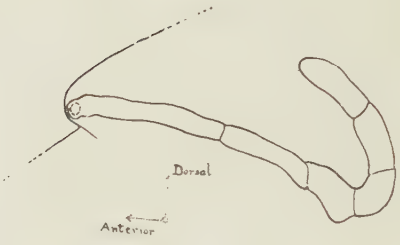
Tetranychus bimaculatus Harvey.

Fig. 1, adult female (X 116); fig. 2, adult male (X 150).



MICROSCOPIC CHARACTERS OF TETRANYCHUS BIMACULATUS HARVEY

FOR EXPLANATION OF PLATE SEE PAGE 678



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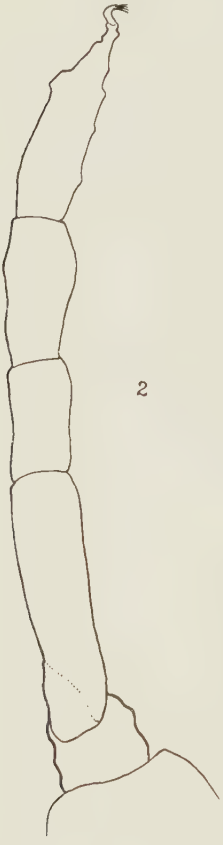

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Posterior

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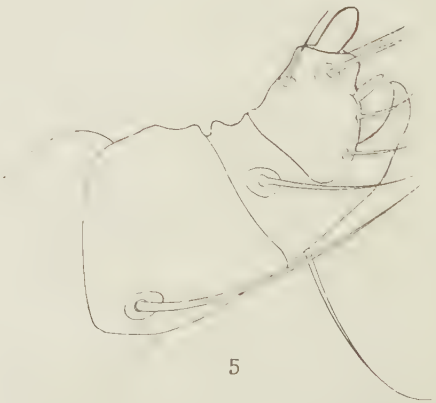

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MICROSCOPIC CHARACTERS OF TETRANYCHUS PACIFICUS, NEW SPECIES

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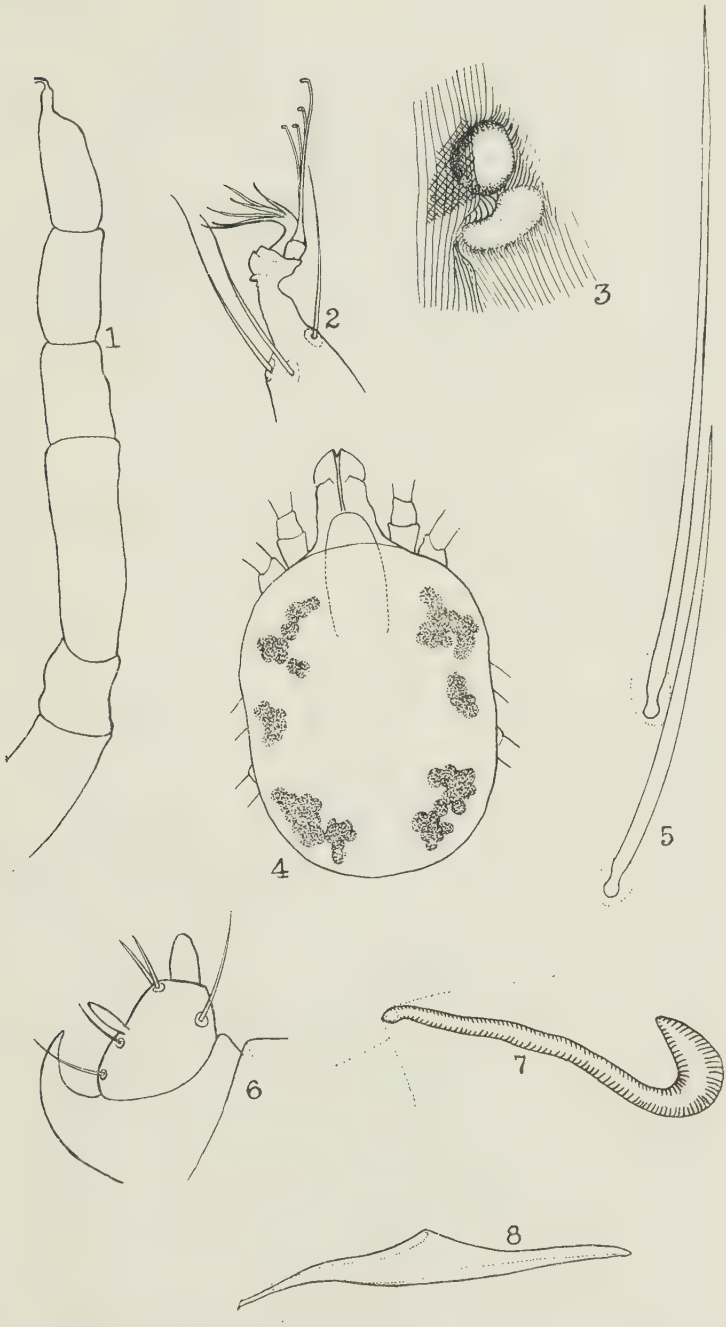

MICROSCOPIC CHARACTERS OF TETRANYCHUS SEXMACULATUS RILEY, NEW SPECIES

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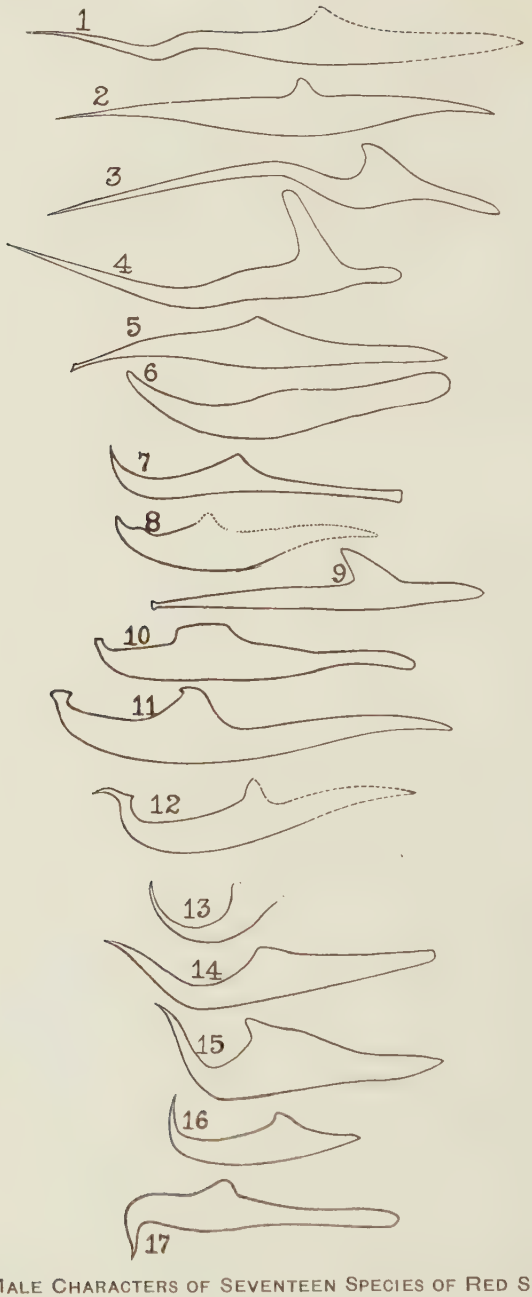

MALE CHARACTERS OF SEVENTEEN SPECIES OF RED SPIDERS

FOR EXPLANATION OF PLATE SEE PAGE 679

1 2

WORK OF TETRANYCHUS BIMACULATUS HARVEY ON COTTON LEAVES

FOR EXPLANATION OF PLATE SEE PAGE 679

1 2
TETRANYCHUS BIMACULATUS HARVEY, ADULT (1) FEMALE AND (2) MALE

FOR EXPLANATION OF PLATE SEE PAGE 679

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